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NOTES OF A METALLURGICAL JOURNEY IN EUROPE.

The Lead and Silver Works of the Hartz Mountains.

BY JOHN A. CHURCH, E. M.*

The mining region of the Hartz mountains is second in importance to that of Saxony alone. Indeed, if the Mansfield copper mines are added to the silver, lead and copper mines of the Upper Hartz we have a district which is in every respect—extent, value of product, number of workmen and intelligent methods of work—the equal of any other similar region in the world. The subject of the present paper is the smelting operations at Clausthal, Lautenthal and Altenau. In former times the "Upper Hartz" was a name given to the works at Clausthal, Lautenthal, Altenau and Andreasberg, each of which had a completely furnished smelting establishment where argentiferous lead ores could be resolved into merchantable lead, silver and copper. When the district passed into the hands of the Prussians, in consequence of the war of 1866, changes were made which placed the region very much higher than it had ever been in the scale of importance. The mines were worked more vigorously, and plans were laid out for increasing the amount of ore treated to 400,000 centners or 20,000 tons (of 2,000 lbs.) per year. The work of the several establishments was redistributed, and fundamental changes were made in nearly every branch of the treatment. Clausthal was made an establishment exclusively for the treatment of the ore, Lautenthal for the separation of the silver from the rich lead, and Altenau for the copper process. Andreasberg alone, on account of the peculiarly rich arsenical ores found there, retained its old works, sending, however, all its copper matte to Altenau. While these changes were in contemplation the introduction, first of the Rachette, and then of the Kast furnace, compelled some delay in order to study the performance of the new apparatus, and though years have passed, the alterations are hardly yet fully carried out.

* Changes have followed each other so rapidly in the Hartz that almost every year has brought out some new process or important modification of old methods. The above notes, therefore, though based on personal observation, have been mainly drawn from the writings of KOCH, WEDDING and BRAUNING and KUHLEMANN. With the exception of Dr. WEDDING all of these gentlemen are actively engaged in the works they have described.

THE WORKS AT CLAUSTHAL.

First in the series comes Clausthal where the ore is run down to metallic lead and copper matte. The process in use is one which was invented at Clausthal, and which, though often derided, has probably had more influence upon the smelting of galena ores throughout the world than any other. It is the method known as precipitation. Galena, which is the main constituent of the Hartz ores consists of lead and sulphur. In all the works hitherto described in these notes the sulphur has been removed chiefly by combining it with oxygen—roasting. At Clausthal iron is used instead of oxygen. At first the metal was used direct, but it was afterwards found that a silicate rich in iron oxide served not only as well but better than the metal itself, and inasmuch as there were large stores of such silicate containing small amounts of copper and silver which could be had for the mere cost of transportation the discovery was one of great importance. Finally another modification was made which now forms the existing mode of treatment.

One of the fundamental differences between the removal of sulphur by oxygen and by iron is that in the former case the product is volatile and passes directly out of our hands as a gas, while in the latter it is a solid, called matte. If it were possible to produce a matte containing nothing but iron and sulphur there would be absolutely no drawback to the precipitation as a process for pure lead ores, for the matte could be thrown away and the sulphur thus removed from the process. But a matte produced by smelting lead ores always contains lead, and if silver and copper are also present these metals always pass into the matte in quantity sufficient to make their extraction a necessity. The mode of this extraction is the same throughout the world. There is no substance available to the metallurgist which will take the sulphur from the iron in the matte as the iron has taken it from the lead in the ore, except one—that is oxygen—and mattes, therefore, are everywhere roasted. The oxidation of the sulphur is accompanied by oxidation of the iron, and as this is the first step toward the formation of a silicate, it is only necessary to melt the roasted matte with quartz in order to remove the oxidized iron in the form of a slag. This treatment of the matte is a serious item of expense.

The certainty that the matte will contain the copper is by no means an evil.

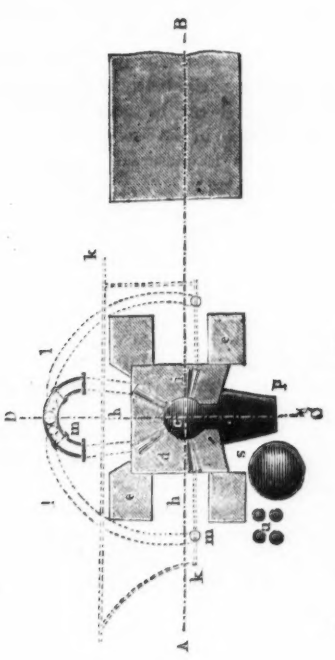

Fig. 14.

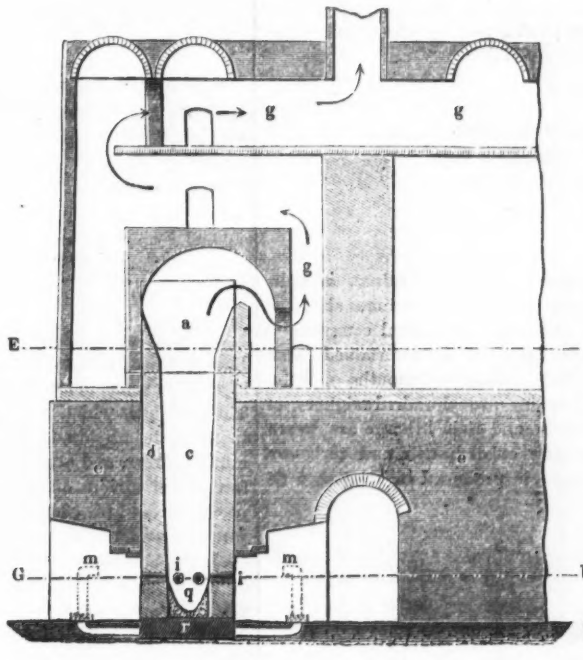

Fig. 13.

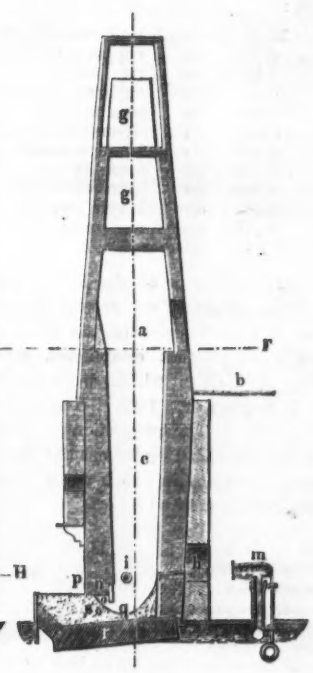

Fig. 19.

THE KAST FURNACE AT CLAUSTHAL.

On the contrary, were it not so the metallurgist would be puzzled to know how to separate his copper from the lead. The whole treatment of sulphides containing copper is based upon the chemical fact that copper and sulphur will in all cases unite in the furnace, provided the amount of sulphur present is not sufficient for both the iron and the copper; the former can be removed by the addition of quartz, a slag being the result. This action is so certain that the metallurgist, who has a copper matte which has been roasted "dead," that is, has had all the sulphur removed and the copper and iron completely transformed to oxides, would have no hesitation in charging it in a furnace with an iron pyrites containing only quartz, iron and sulphur, and no copper at all. The result in all cases is that the copper unites with the sulphur and the quartz with the iron oxide.

In the Hartz, however, a different system has lately been followed. Instead of melting the ore with a slag rich in iron, to remove the sulphur, and melting the roasted matte with another slag rich in silica, to remove the iron oxide, they combine the two processes and melt the ore and the roasted matte together. As the ore contains both quartz and sulphur the oxidized iron passes partly into the slag with one and partly into a new matte with the other. The matte, therefore, makes a continuous round, being roasted and re-smelted with the ore five or six times.

It is easy to see that this is really no more nor less than a roasting process though the roasting is transferred from the ore to a matte. There are two advantages to be obtained from this treatment. One is the less bulk of the matte to be roasted, amounting to not more than half, or at most, two-thirds the ore. The other is that the sulphides of iron are in all cases much easier and cheaper to roaste than the sulphides of lead. They contain more sulphur, require less fuel, and present less liability to sintering and imperfect roasting. Other important advantages are, first, that the lead and silver having been mostly removed, the loss from volatilization is much less, and, second, that the sulphur in the matte can be utilized by making sulphuric acid from it, while the ore is useless for that purpose because it contains so little sulphur.

The ore treated at Clausthal had, according to KOCH (1869), the following composition:

71.676	per cent.	lead sulphide or 62.07 lead.
0.945	do	copper sulphide 0.75 copper.
1.880.	do	zinc sulphide.
0.537	do	antimony sulphide.
1.410	do	iron sulphide.
0.113	do	silver sulphide or 0.983 silver.
4.139	do	iron carbonate.
0.150	do	alumina
2.380	do	lime carbonate.
1.460	do	baryta sulphat
0.075	do	magnesia.
15.235	do	silica.

This is a mixture of ores obtained from a great number of mines, and the occasional preponderance of ore from some one mine will sometimes alter the composition of the charges smelted for a few days The usual composition of the charge, as at first established, may, however, be ascertained from the following quantities which were smelted during the months of July, August, and September, 1869. The quantities are hundredweights of 110 English pounds. The proportions of hearth and rich litharge are worth noticing, for the Clausthal works use the German cupel hearth, and these are therefore the proportions in which cupel scraps are produced in treating a 62 per cent. ore, by this method:

			Per ton.
Ore	33,400 cwt.	100	2000 lb.
Roasted matte	17,565 ,,	52½	1050 ,,
Copper slag	22,248 ,,	66⅔	1312 ,,
Slag from same operation	55,542 ,,	166½	3332 ,,
Cupel hearth	1,112 ,,	3	6 ,,
Rich litharge	624 ,,	2	4 ,,
Scraps	262 ,,	0¾	1½ ,,
Days' labor (12 h)	1,002	3½	3-5ths day
Coke	14,964 ,,	71 1-5	858 lb.
Charcoal	810 ,,		

This is therefore an expense of three-fifths of a day's labor, and 858 pounds of coke per ton of ore. The cause of this large expense of fuel is the use of so much flux, amounting to 284 per cent. of the ore. This excessive proportion of flux is one of the peculiarities of the Hartz. Nowhere else is it used in such profusion, but innumerable attempts to reduce it there have, without exception, failed. When slag is used as a precipitating material a bulky charge is the necessary result, but even when metallic iron was the precipitating agent, 121 per cent of slag was added to the ore. The causes of this peculiarity have never been published.

Considerable changes have been made in the above proportions, the chief of which was to cut down the amount of slag from the same operation repassed, to 75 and 70 per cent. which reduced the flux precipitating material to 190 per cent. of the ore. The charge at one time was made up of 100 ore, 50 roasted matte, 70 copper slag, and 70 lead slag, smelted with about 43 coke. It was found, however, that with these proportions the matte became so rich in copper as to part with some of that metal to the lead. The roasted matte obtained from ore smelted with slags alone contained 3 per cent. of copper, which rose to 8 and even 9 per cent by re-fusion with ore and the lead instead of 0.3 per cent., as formerly, contained 0.6 to 0.7 per cent. of copper. This increased the difficulty and cost of desilverization, and the proportion of roasted matte was diminished to 28 per cent. of the ore. The exact composition of the new charge I have not been able to obtain, but it is probably about the following: Ore 100, roasted matte 28, slags 150-170. After the change the copper in the matte sank to 5½ per cent., and in the lead to 0.4 and 0.5 per cent.

The products during the above-mentioned 3 months were –

	From 100 Ore
Lead, 21,830 cwt.	65½
Matte, 24,253 ,,	72⅔

The three methods of treatment successively used at Clausthal, have given the following results in regard to product:

With metallic iron.	With copper slag.	With roasted matte.
Lead, 54	65	65½ and 65
Matte, 44	55	72⅔ and 66

The simplicity of this precipitation method would recommend it in nearly all cases were it not for the large increase of cost which results from using so much flux, and the production of so much matte. The practice of adding puddle and reheating cinder to lead ores in the shaft furnace, is now so common that the business of lead smelting has, in some regions, almost become auxiliary to the manufacture of iron. Under these circumstances it is always a question whether the operation of roasting, costly in plant and in practice, cannot be supplanted by merely increasing the proportion of iron flux, and re-charging the matte formed. In those cases where ores, pure in lead and rich in silver, are smelted for the silver they contain, and there is therefore no desire to keep the lead pure, it seems probable that this method would be found decidedly advantageous.

The lead obtained is not pure. Analysis of the lead and matte given by KOCH, are as follows; although obtained by the former precipitation with copper slag, they fairly represent the same products from the present process.

	Lead.	Matte.
Antimony	0.618	0.350
Copper	0.276	4 392
Iron	0.002	55.720
Zinc	0.008	1.125
Silver	0.127	0.029
Lead	98.969	7.984
Sulphur	....	29.546
	100	99.146

The slag is maintained with great regularity between a proto-and a bi-silicate. It is rich in iron, very poor in lead, and can be thrown away at once. Only a very small portion—that which solidifies in the fore hearth—must be re-charged on account of grains of lead and matte mechanically contained in it. The following is an analysis of this ordinary slag:

Silica	43.60	Magnesia	1.56
Iron oxide	31.68	Lead oxide	0.70
Alumina	15.50	Silver oxide	0.000087
Lime	6.50		
			99 54087.

The furnaces in which the fusion takes place are of two kinds, the round or Kast furnace, and the Rachette. The round furnaces at Clausthal form an interesting series of experiments in the most recent progress of lead metallurgy. The principles which were introduced into the construction of lead furnaces by the English in Spain, 30 years ago or more, and have been modified by PFANDERHEIDEN, PILTZ, and others, have also made their way to Clausthal. Five round furnaces of various dimensions and construction are found there. One of the peculiarities of the Clausthal system of smelting is that the ore must be in the form of powder, and this formerly caused so much dust that from 5 to 8 per cent. was taken from the dust chambers. This gave rise to a very unusual mode of building the furnaces. A row of heavy brick piers was built, and the intervening spaces arched over. On this arches was raised a line of dust chambers, which not being intended to condense volatilized lead, but merely to give the fine dust opportunity to settle, could be placed immediately over the furnaces. But the result of this mode of construction was to place a limit to the size of the furnace which could be built between two piers, and when the new doctrines in furnace building began to spread Mr. KAST, director of the smelting works at Clausthal, had to experiment to ascertain what were the smallest diameters that would prevent the dust from flowing out of his furnaces. At first a furnace 3 feet in diameter at the tuyeres and 4 feet at the top was built, but the amount of dust was still excessive. Then the diamenter at the mouth was increased to 4½ feet, which caused a reduction of the flue dust to 2 per cent. The slowness of the ascending current of gas in the upper part of the furnace also affects very favorably the utilization of the coke, and the amount of material run through in a day. The following table gives a comparison of the four round furnaces with a Rachette. All of the round furnaces have the same diameter at the tuyeres, 3 feet, and the same height, 21 feet. The diameter of the Rachette at the tuyeres is also 3 feet.

Diameter at mouth.	Coke per 100 ore.	Flue dust.	Time to smelt 11,000 lbs. ore.
No. 1....4ft. 2in.	42.39	2.8 per cwt.	73.2 hours.
No. 2....4ft. 8in.	41.85	2.1 "	71.8 "
No. 3....5ft. 0in.	41.74	1.7 "	71.2 "
No. 4....5ft. 3in.	41.62	1.1 "	69.2 "
Rachette..4ft. 9in.	44.3	1 "	93.2 "

The round furnaces, called also Kast furnaces after the Director of the works, do not differ from the general type of modern lead furnaces, except that, being built between piers of masonry, they are not approachable in all cases. They

are made with fore hearth, over the dam of which the slag runs without cessation. The number of tuyeres ranges from 4 to 7.

Like so many lead furnaces in Europe, these are built of ordinary red brick, only a few fire brick being placed around the tuyeres, and these are in fact often omitted. These furnaces have made an uninterrupted campaign of 2 or 3 years, a result which is due to the accuracy with which the composition of the slag is calculated and maintained. The ore and flux are spread out in layers upon each other on the floor at the furnace mouth, and charged equally over the whole surface of the furnace, the coke being spread out in the same way. The pressure of air is 10 to 12 lines of mercury.

Figures 12 to 14 give sections of the Kast furnaces. The dimensions of one are

Height	20ft.
Diameter at mouth	5ft.
Do. at tuyeres	3ft.
Do. at sole	2ft. 4in.
Number of tuyeres	4
Pressure of blast	11—14 lines of mercury.

They are open at the mouth, having no hopper nor cylinder. The ore and coke are spread evenly over the surface, the ore being thrown from wooden troughs, and the coke from flat baskets. The charges for 24 hours are always made up in the morning, so that at night nothing but tapping the furnace and throwing the slag off the slag run takes place. All furnaces at Clausthal have a fore hearth, over the edge of which the slag runs, passing down a narrow inclined bank made of brasque. It solidifies on this, and is thrown to one side by the workman who wields a 2-pronged fork. The lead is not tapped from the body of the furnace, but from the front hearth where it collects. This front hearth is formed inside of an iron box projecting from the furnace, and in the side of this box is the tap.

In addition to these Kast furnaces Clausthal possesses a Piltz of the same pattern as those at Freiberg, but with some judicious alterations in the method of suspension. It is octagonal, 24 feet high, 4ft. 8in. diameter at the tuyeres, and 6ft. 8in. at the mouth. The 8 water tuyeres are 15 inches above the slag spouts. It was attempted to run this furnace with a closed hearth, but outside modifications do not seem to succeed in the Hartz, and it was found impossible to produce a fusible slag. The furnace was accordingly narrowed to 4ft 2in. at the tuyeres, and fitted with a front hearth. It is now in successful operation.

Notes on the Treatment of Cupreous Iron Pyrites.

BY GEORGE RIEKEN AND MIGUEL YGLESIAS.

A very large proportion of the ore produced from the pyrites in the south of Spain and Portugal is consumed at the various chemical works in this country, the remainder being treated at the mines by artificial cementation.

Pyrites, used in the first instance for the production of sulphuric acid, leaves coppery residues, and thanks to the labors of Mr. William HENDERSON, of Glasgow, and Mr. WIGG, the managing partner of the Runcorn Works, it is now possible to extract at a very small cost all the copper contained in these residues. By Mr. HENDERSON'S process more than 10,000 tons of copper are annually manufactured, and this new branch of industry, beneficial in itself, has given a great impetus to the pyrites trade, this mineral having now a commercial value as an ore of sulphur of copper or of iron.

Besides this, the recent investigations of Mr. CLAUDET show the practicability of extracting cheaply from these pyrites the small quantity of auriferous silver which they contain. This renders absolutely perfect the process of metal extraction by the wet way, and marks a new epoch in metallurgy. Mr. HENDERSON'S process seems, however, to be only beneficially applicable to ores which, before calcining, contain under 4 per cent. of copper, so that the large quantities of cupreous pyrites, which contain a higher per-centage of copper, must still be treated only by the copper smelter.

It is impossible to separate by the ordinary mechanical means the rich from the poor pyrites, because the gangue is not a substance of different specific gravity, but is the iron pyrites itself. It might seem, however, that by manual labor some classification, based on difference of color, might be effected ; but side by side with the dark ore called "negrillo," so rich in copper, is found pyrites, both white and yellow, also of high percentage ; and on the other hand many ores, both light and dark, have little or no copper.

The question therefore arises whether it is better to separate as well as possible the rich ores and ship them to Swansea, or whether the rich and poor together should be treated at the mines. The seller of these ores, which are rich compared with ordinary cupreous iron pyrites, but very poor in comparison with the ores of Chili and the Cape, is subjected to very great disadvantages at Swansea—principally from the antiquated system of assaying by the Cornish or dry method. This method, which only gives a portion of the copper contained in the ore, tells greatly in favor of the buyer of poor ores. Dr. PERCY states that the Cornish assay shows from 20 to 66 per cent. under the true quantity of copper contained in the ore, according as the ore may contain from fifteen to one-half per cent., so that the poorer the ore, the greater is the loss which the seller has to suffer in this respect. In former times this system was very fair, because it was supposed, and correctly so, to represent, not the quantity of copper contained in the ore, but the quantity which the smelter would be able to extract from it, according to the means then at his disposal. Now, however, things are very different, and the worst managed works will produce eight or nine per cent. of copper more than the amount fixed by the assay on which the ores are purchased. The two following cases mentioned by Dr. PERCY are good practical comments on this point. A manufacturer purchased some works, and out of the waste heaps left there he realised sufficient to pay for the whole property, the price of which amounted to several thousand pounds ; and in another case, the buyer of some old copper works obtained in value more copper from the furnace bottoms than the purchase-money.

There are many other trade customs at Swansea which operate so greatly against sellers of ores containing only between five and ten per cent. of copper, that it is certain that not more than one-half the copper contained in an ore of, say seven per cent., will be paid for by the smelter, and although it is but fair that he should make a profit, in such a case the profit would be too large ; and if to ship an ore of seven per cent. the miner has to separate and classify large quantities of ore, he will assuredly lose money if he is only paid for half the copper contained in the ore he does ship, and it would appear better to devise some method of extracting the metal on the spot, or at all events to concentrate it in such a manner that the product could be profitably exported.

In considering what should be the appropriate metallurgical treatment of these ores, great weight must be placed on the question of local advantages or disadvantages, and while recognizing the defects of the system of artificial cementation, as practised in the district lying between the rivers Tinton and Guadiana, it does not seem any better to introduce, as has been proposed, the processes in vogue at Swansea, Mansfield, the Hartz, or Sweden. Undoubtedly at Swansea little or no room is left for improvement, but situated in close proximity to coalfields, and being able to make up, from the copper ores of all classes imported there, a heterogeneous mixture admirably suited for smelting, it possesses advantages which it is impossible to transfer to a locality where coal could only be imported at a costly rate, and where there is no absolute uniformity in the chemical constitution of the ore to be treated. On the other hand, the extraordinary effects of the very peculiar climate of the mining district in question make it possible to do what cannot be done either in England, in Germany, or Sweden. The peculiar climate places at our disposal three valuable agents in the shape of the burning heat of the days, the comparatively intense cold of the nights, and the copious morning dew. Thus the surface of the ground forms a vast natural laboratory, where creating and decomposing forces are continually at work, and though they escape observation at first, from the gradual and quiet way in which they act, their results are so startling as to astonish any who will examine a heap of ore before and after being exposed some time to the atmosphere. A great improvement in the present local system of artificial cementation can, therefore, be effected by submitting these spontaneous natural forces to the regulating intervention of science and common sense.

The great defects of artificial cementation are that only part of the copper is extracted from the ore, and that far too large an amount of iron is used in proportion to the copper precipitated from the solutions. The cause of the first of these defects exists in the imperfect sulphatisation of the copper, owing to the system of calcining the pyrites in heaps and in pieces of all and of every size, and the cause of the wasteful expenditure of iron is the formation of excessive quantities of sulphate of peroxide of iron, which is also a result of the system of calcining. This, of course, is the reason of the deplorable commercial results of this system, whereby the copper is produced at a great cost, while the waste products are left with nearly as large a proportion of metal as was contained in the ore before working it, and why the Government mines of Rio Tinton, instead of contributing to the revenues of the country, produced an absolute loss of £25,000 on the two years' working of 1867-8 and 1868-9, as it cost £134,000 to produce 2,000 tons of copper.

In the waste heaps which result from this system, spontaneous sulphatisation takes place after a time, and nowhere can better hints be found for improving the present process than in studying the transformations these enormous deposits of abandoned material undergo when subjected to the action of the atmospheric influences of the climate of the district.

In the waste heaps the copper exists in three different states, all insoluble in water, viz., sulphide, peroxide, and protoxide. The residues contain also much sulphide, proto-sulphate, and persulphate of iron. These salts rapidly appear in efflorescent form, and the particles of copper, which on the calcination are driven into the center of the lumps, forming nuclei of insoluble sulphides, are brought out to the surface during this spontaneous sulphatisation, and their extraction is thereby rendered easy.

The sulphates of iron, oxidised by the night air, and constantly reproduced by the heats of the day, are dissolved by the dew or by rain, and are then decomposed into neutral and basic persulphates of iron, viz., Fe^2O^3, 3 SO^3 and 2 $Fe_2O^3SO_3$. The latter is precipitated, but the first remains in solution, and running over the heap dissolves the sulphides and oxides of copper.

The action of the ferric persulphate on the sulphide of copper is expressed by the following formula : 2 (Fe^2 O^3, 3 SO^3) + Cu^2S = 4 FeO, SO^3 + 2 CuO, SO^3 + S.

So it appears that, besides soluble sulphate of copper, pure sulphur is also formed on the heaps, and this fact, barely noticed at present, may also be utilized to increase the commercial value of the proposed improvement on the defective system of artificial cementation.

The conversion of the protoxide of copper by means of the persulphate of iron into soluble sulphate of copper, is explained by the following formula : Cu^2O +

$HO+Fe_2O_3$, $3\ SO_3 = 2\ CuO,\ SO_3 + Fe_2O_3,\ SO_3 + H$, and that of the peroxide by $CuO + Fe_2O,\ 3\ SO_3 = CuO,\ SO_3 + Fe_2O_3,\ 3\ SO_3$.

In the heaps of raw ore lying about at the Fronteriza Mines may be ob erved the spontaneous elimination of *native sulphur*, which curious fact may be explained by GMELIN'S formula: $FeS^2 + 4\ O = FeO,\ SO_3 + S$.

The presence of free sulphuric acid among the heaps of burnt ore is also to be noted, and according to MITSCHERLICH the bisulphuret of iron is oxidised as follows: $FeS_2 + 4\ O = FeO,\ SO_3 + SO$.

The creation of excessive quantities of persulphate of iron, which gives rise to the consumption of two or three times the quantity of iron really sufficient to precipitate the copper from the solutions, is caused by the calcination of the pyrites in large heaps in the open air. This important operation, if carried on without any appliance for regulating the temperature, cannot possibly give good results, and the copper will be but partly converted into sulphate.

If the ore were powdered and then calcined in appropriate kilns, this perfect sulphatisation is not only possible, but would be accompanied by the complete destruction of those iron vitriols which, in their different combinations with sulphuric acid, are the cause of the waste of iron alluded to. On the other hand this persulphate of iron in solution presents a ready means for completing the sulphatisation of the copper, which has been ineffectively done by burning the ore in heaps.

By the means proposed, not only could fine copper be delivered in the English and French markets at a cost of about £40 per ton, but it will also be perfectly possible to manufacture from these various forms of persulphate of iron, all the metallic iron requisite for the precipitation of the copper.

It is a mistaken notion to suppose that the sulphur is wasted in these processes, It forms a powerful heating agent, doing away with the necessity of fuel, and the sulphurous acid given off by the combustion of the sulphur acts as a chemical agent to transform the copper from an insoluble sulphide into sulphate.

There result from these oporations residues containing silver and iron vitriol which latter, being distilled, will give off sulphuric acid, which, in combination with salt and manganese ore, both of which are at hand, will enable the silver to be extracted in the form of chloride.

It is therefore clear that the process of artificial cementation can be profitably conducted at the mines. On the other hand, natural cementation, as practised at San Domingos, Lagunazo, San Vicente, and Fronteriza, offers still greater advantages. The precipitate is far purer, and is produced at half the expense incurred in artificial cementation as carried on at Rio Tinton and Tharsia. Natural cementation has also been profitably tried at Rio Tinton; and at the very time the artificial cementation was being carried on at a loss, a profit of £1,600 was made on the production, equal to fifty-three tons, of pure copper in the natural way.

There is, however, still much to be learnt from Nature, for it is clear that by some mysterious process copper is produced in the metallic state without either calcining or the presence of metallic iron. At Lagunazo large lumps of pure copper have been found in natural crevices in the mine, and especially in the Sotiel-Coronada Mines is to be noticed the presence of innumerable particles of pure copper, filling up the pores of the wooden remains of the hydraulic apparatus of the Romans. The gallic acid in the oak may possibly have added to precipitate the metal in this instance. *Iron.*

THE NEW CABLE.

Particulars of the Latest Atlantic Expedition—Past Achievements and Present Risks.

[From the London Times, June 11.]

The Great Eastern steamship has once more started upon another of those missions for which she is so eminently adapted, and which she has already so ably fulfilled upon three occasions. In company with the Edinburgh and the Hibernia, she is now on her way to lay a fourth telegraph cable across the bed of the Atlantic, the squadron having left the Portland road for Valentia at 10 o'clock on Sunday morning. Although this is nominally the fourth cable, it is really the fifth that has been laid on the same course—the first having been laid by the Agamemnon and the Niagara, in 1858. This cable, however, worked only for a few weeks, and then failed to transmit signals, since which time it has been left to itself on the bed of the ocean, and its existence practically ignored. In 1865 the first attempt was made by the Great Eastern to lay an Atlantic cable, which, however, was for the time unsuccessful, the cable parting in 2,000 fathoms of water, and, although grappled for, and three times hooked, it was not then recovered, owing to the grappling gear giving way under the severe strain. In the following year a second cable was successfully laid, and the broken cable of 1865 was recovered and completed. The year 1869 witnessed the laying of the third, or the French Atlantic cable, from Brest to St. Pierre; the present forming, therefore, the fourth practical cable. The squadron to which the laying of it has been intrusted consists of the Great Eastern, Capt. HALPIN, who is in charge of the expedition; the Hibernia, 3,000 tons, Capt. CATO; the Edinburgh, 2,300 tons, Capt. MANNING, and the Robert Lowe, 700 tons, Capt. TIDMARSH. The last three vessels are all screw steamships, the Great Eastern having both paddles and screw. The electrical staff is in charge of Mr. LAWS, Capt. HALPIN'S chief assistant in the engineering department being Mr. LOUDON, while Dr. W. H. ALLCHIN is physician in charge of the expedition for a second time. The task of organizing and arranging the expedition has devolved upon Admiral SHERARD OSBORNE, who has most successfully accomplished his object.

When the project of a fourth Atlantic cable was started, it was proposed to lay it from Porthcurno, on the Cornish coast, direct to Halifax, and thence to New York. In consequence, however, of the amalgamation of the Atlantic Telegraph Company and the Société du Cable Transatlantique Français, and it being desirable, moreover, to reduce the risk incident to submarine lines by laying the cable in shorter lengths, it was decided to lay it between the same points as the previous cables—viz., Valentia and Heart's Content, Newfoundland. The course will be to the north of the 1865 cable, which the new cable will not approach nearer than thirty miles, except at the shore ends. Heart's Content and Placentia are already connected by a land line, and a part of the work of the present expedition is to lay a double line of cable from the latter place to Sydney, Cape Breton. Three different types of cable are to be used, each of which embodies features distinct from the others, and which have been suggested by previous experience. These types, known as A, B, and C, are the shore ends, the intermediate cables, and the deep sea cable. The shore end is, of course, a very heavy cable, capable of meeting any contingency that might arise from coasting navigation, and extending from three to five miles out, according to circumstances. The intermediate cables are of lighter and slightly varying patterns and are continued from the shore ends for distances of from 150 to 250 miles, when they are joined by the deep sea cable, which is of a still lighter design.

As soon as the shore end has been laid it will be brought direct into the test-room at Valentia, and connected with instruments. A series of tests will be continuously made to determine the resistance, insulation, continuity, and conductivity of the cable. A code of signals will be used by which communication will constantly be maintained between the shore and the ship. The positive or negative currents from the shore will produce in the ship's insulation galvanometer deflections either to the right or left, which will represent dots and dashes in the Morse Code, the left, or negative, being equivalent to a dot, and the right, or positive, to a dash. Continuity tests from the shore will be applied every five minutes during the time of laying. Once every day the ship will signal to the shore the distance run, the number of miles paid out, and the insulation resistance per mile.

The cable is distributed between the Great Eastern, the Hibernia, and the Edinburgh, the Robert Lowe carrying the shore ends and the electrical stores. The Great Eastern has on board about 2,600 miles of cable for the Atlantic line, the Hibernia 490 miles, and the Edinburgh 365 miles for the Placentia lines. The Hibernia also carries the shore end for Heart's Content. There is, of course, an overplus of cable, but in calculating the length required, the repairs to the 1865 cable had to be taken into account. There are on board the three ships 28,000 fathoms of grappling rope, besides 14,000 fathoms of smaller tackle, and fifteen miles of coir-buoy rope, so that they are well equipped in this respect. When the Robert Lowe has laid the shore end at Valentia, she will return to the Thames and ship the four shore ends for the two Placentia cables, to which place she will proceed, and join or await the other vessels. On leaving Valentia, the Great Eastern, accompanied by the Hibernia and the Edinburgh, will proceed to lay the main cable to Newfoundland. When this has been effected the two latter vessels, with the Robert Lowe, will lay the Sydney cable, after which the Hibernia will fill up with coal and rejoin the Great Eastern at Heart's Content. The two will then proceed eastward along the course of the 1865 cable to the point of rupture, which is 568 miles from Valentia, where it will be grappled for, and, it is to be hoped, found and repaired. On leaving Sydney the Robert Lowe will proceed to repair the Duxbury section of the French Atlantic cable, which was broken last month close in shore. She will also effect some repairs in the cables belonging to the Newfoundland Telegraph Company. The Edinburgh, when her task has been completed, will fill up with coal and return to the Thames to ship a portion of the Brazilian cable, the greater part of which it is intended to lay during the present year.

It may here be interesting to note the lengths of each of the Atlantic cables. That of 1866, which was recently broken, is 1,896½ miles long, and the cable of 1866 is 1,868½ miles. The French cable of 1869, from Brest to St. Pierre, is 2,557 miles in length, while the line about to be laid will be about the same length as that of 1865. Since the latter cable broke, the French cable parted, 208 miles from Brest, in about 500 fathoms of water. The accident was repaired by the Hibernia, a length of 100 miles having been cut out and replaced by a similar length of new cable.

It will thus be seen that the work of the expedition will consist in laying three sections of submarine cable and in recovering and repairing several others. By far the most interesting and important feature under the second head is the grappling for the cable of 1865, which broke a few months since. It will prove interesting, inasmuch as it will determine whether the physical condition of a cable which has been submerged for eight years is such as to allow of its being raised, or, in other words, whether the outer covering will have become so deteriorated that it will no longer possess the strength necessary to resist the great strain which will be brought upon it in raising it. Of its being found and grappled there is but little doubt, the same thing having been accomplished before, under less favorable circumstances, and with more limited experience than in the present instance. The matter derives its importance from the fact that if the results are successful it will prove a great commercial gain to the enterprising company to whom it belongs. The cable has parted in about 1,900 fathoms of water, and so far as has been ascertained the bottom is of a favorable nature for grappling operations. The Great Eastern and her consort will continue their efforts to recover the cable up to the middle of September, or even longer if necessary, for she is equipped for a four months' voyage. It is, however, to be hoped that her labors will have terminated successfully before that time, and that yet new honors will have been added to the science of submarine telegraphy.

THE COAL TRADE.

NEW YORK, July 11, 1873.

Anthracite.

The Coal Trade presents no feature of special interest for the current week under review. Buyers are accepting the situation fully and realizing that the policy of the Anthracite coal producing companies in inaugurating the new system of moderate advances from month to month will be adhered to, and we feel satisfied that manufacturers and consumers will act wisely in not delaying their purchases. A steady movement of tonnage for the balance of the season is necessary to bring forward the same amount of coal as came to tide-water last year. With the increased consumption this year for iron purposes, as well as the greater consumption for domestic uses, in the earlier months of the year, by reason of the prolonged winter and generally backward spring, we are certainly warranted in the assertion that last years' output of coal will be required in 1873. Should the average annual increase of ten per cent. be also required, the trade will be very active for the remaining months of the year.

Vessels are moderately plenty at the various shipping points. Coal is backward in coming forward thus far this month. An interruption usually occurs about the 4th of July. There are some local strikes prevailing, but it is to be hoped that the men may not be influenced by their leaders to inaugurate any general strike.

The monthly circulars show a uniform advance for July of about ten per cent. per ton over June prices, and we find a liberal supply of orders in the hands of shippers for delivery during the current month. Freights are generally unchanged. Messrs. Lewis Audenried & Co., issue the following circular:

NEW YORK, July 1st, 1873.

The following are the Circular prices fixed by the Coal Companies which we represent, at which we will receive orders for delivery in July, subject to their printed conditions:

SHIPPED FROM PORT JOHNSTON, ELIZABETHPORT, HOBOKEN, AND TRENTON.

	Lump.	Steamer.	Broken.	Egg.	Stove.	Chestn't.
W. C. and I. Co., Wilkesbarre	4.75	4.85	4.95	5.10	5.30	4.75
L. C. & N. Co'. Old Co'. Lehigh	5.70	....	5.55	5.55	5.60	4.90
" " Newport	....	....	5.05	5.20	5.40	4.80
" " Plymouth Red Ash	....	....	5.05	5.30	5.50	4.80
Honeybrook Lehigh	5.60	....	5.50	5.50	5.60	4.85
Fulton, "	5.70	....	5.55	5.55	5.60	4.90
Scranton	4.60	4.75	4.95	5.15	5.45	4.75

Anthracite Coal Trade for 1872 and 1873.

The following table exhibits the quantity of Anthracite Coal passing over the following routes of transportation for the week ending July 5, 1873, compared with the week ending July 6, 1872.

COMPANIES.	1872. WEEK.	1872. TOTAL.	1873. WEEK.	1873. TOTAL.
Phila & Reading R.R†	64,474	2,316,869	72,858	2,572,239
Schuylkill Canal	20,863	362,312	20,774	295 539
Lehigh Valley R. R.	49,7.6	1,778,68.	57,999	1,805,221
Lehigh & Sus. R. R.	19,979	829,555	32,180	991,058
" " Canal	20,253	290,721	14,141	257,847
Scranton North	12,582	3.9,139	21,854	396,481
" South	35,479	1,102,412	37,591	1,104,449
Penn. Coal Co., rail	19,546	586 667	26 762	588,573
" " " canal	....	2,634	253	3 341
Del. & Hud C. Co. Canal	32,680	524 026	33,417	554,072
" " East	9,082	335,262	6,189	201,664
" " West	7,738	182,979	9,255	235,980
" " South	6,060	184,664	719	126,153
Shamokin	7,803	268,350	10,344	285,865
Trevorton	....	....	....	....
Lykens Valley Coal Co.	....	....	....	....
Wyoming North	10,547	333,462	10,785	371,762
Wyoming South	....	....	....	....
P. N. Y. C. & R. R. Co.	....	....	....	....
Williamstown Co'y	....	....	....	....
Big Lack Co'.	....	....	....	....
Total	316 687	9,45,,643	354,514	9,848,264
1872			316,687	9,450,543
Increase			37,827	397,721
Decrease				

These figures are for the week and fiscal period commencing Nov. 30

† Less coal transported for Company's use and Bituminous coal.

Bituminous Coal Trade, 1872 and 1873.

The following table exhibits the quantity of Bituminous Coal passing over the following routes of Transportation for the week ending July 5, 1873, compared with week ending July 6, 1872.

COMPANIES.	1872. Week.	1872. Year.	1873 Week.	1873 Year.
C. & O. Canal	15,236	285,384	17,203	2:1,151
B. & O. R. R.	23,708	624,463	24,344	701,920
Penn. S. Line	....	.....	866	43,333
H. & B. T. R. R.	4,579	148,843	4,872	228,510
*Harrisburg & D.	6 711	262,961	6 076	185,289
*L. V. R. R.	354	15,989	730	16,648
P. & N. Y. C. & R. Co.	5,500	197,629	6,142	169,187
Cumberl'd Branch Canal	3,773	92,245	4,384	47,364
" Railroad	476	9,272	618	56,015
Total	60,337	1,636,816	63,227	1,729,347
	....		60,3.7	1, 36,816
Decrease	....			
Increase			7,900	92,471

Philadelphia & Reading Railroad and Branches.

COAL TONNAGE

For the Week ending Saturday, July 5, 1873.

BY RAILROAD.—ANTHRACITE.

PASSING OVER MAIN LINE AND LEB. VAL. BRANCH.

	Tons. Cwt.
From St. Clair	18,624 16
" Port Carbon	1 618 13
" Pottsville	1,307 01
" Schuylkill Haven	19,094 00
" Pine Grove	2,247 07
" Tamaqua	6,400 12
" Harrisburg	
" Dauphin	5 932 19
Total	55,183 08

FOR SHIPMENT BY CANAL.

Passing Frackville Scales	6,278 09
" Mill Creek "	1 949 06
" Schuylkill Valley Scales	70 17
" Mt. Carbon "	1.340 18
" Cressona "	7,197 06
" Pine Grove "	364 04
" Tamaqua "	1,648 01
Total	18,848 10

SHIPPED WESTWARD VIA CATAWISSA AND WILLIAMSPORT BRANCH AND NORTHERN CENTRAL RAILROAD.

Via Catawissa & Williamsport Br.	1.2 05
" N. C. R. R. passing Locust Gap	1 498 47
" " " Shamokin	3,3.4 16
" " " Herndon	....
Total	4,945 08

SHIPPED WEST OR SOUTH FROM PINE GROVE.

Via Schuylkill & Susquehanna R. R.	983 02
" Lebanon & Pine Grove Branch	1,316 00
Total	2,279 02

CONSUMED ON LATERALS.

From Frackville Scales	368 12
" Mill Creek "	490 19
" Schuylkill Valley Scales	455 12
" Mt. Carbon "	619 11
" Cressona "	68 03
" Pine Grove "	65 19
" Tamaqua "	259 18
Total	2,438 14

LEHIGH AND WYOMING COAL.

Received via Silverbrook Junction, Sent East	6,092 13
Cat. & Wpt. Br. Sent West	....
" " Rupert, Cat. & Wpt Br.	....
" " Allentown, E. Penn's Br.	29 09
" " Alburtis, " "	....
" " Oreland, G. & N. Br.	716 02
" " Willow Street R. R.	373 00
Total	7,209 04

BITUMINOUS.

From Harrisburg	6,056 02
" Connecting R. R., G. & N. Br.	
" Junction R. R.	20 00
Total	6,076 02

COAL FOR COMPANY'S USE.

Anthracite	5,506 19
Bituminous	128 17
Total	6,635 16

RECAPITULATION.

	Total for Week.	Corres-p'g week last year.	Increase and Decrease.
Passing over Main Line and Leh. Val. Branch	53,986 08	57,067 11	d 1,081 03
For Shipment by Canal	18,848 10	15,898 04	i 2,950 06
Shipped Westward via Northern Central R. R.	4,945 08	3,767 08	i 1,178 00
Shipped West or South from Pine Grove	2 279 02	1,248 13	i 1,0'0 09
Consumed on Laterals	2,438 14	1,375 02	i 1,063 12
Lehigh and Wyoming Coal	7,228 04	1 014 17	i 6,193 07
Total Anthracite paying freig't	91,7.6 06	80,371 15	i 11,734 11
Bituminous	6,07e 02	6,719 18	d 634 16
Total of all kinds paying freig't	97,782 08	87,092 13	i 10 699 15
Coal for Company's use	5,635 16	2,882 06	i 2,753 10
Total Tonnage for Week	103,418 04	89,964 19	i 13,451 05
Previously this year	32.6371 13	3'34478 05	i 82,193 08
Total to date	3320069 17	3224443 04	i 95,646 13

SHIPPED BY CANAL.

From Schuylkill Haven	18 890 10	14,189 10	i 4.661 00
" Port Clinton	1,923 00	1,777 00	i 146 00
Total Tonnage per Week	20,773 10	15,966 10	i 4,807 00
Previously this year	274,764 10	356,553 00	d 81,788 19
Total to date	295,538 00	374,519 19	d 76,981 19

Delaware and Hudson Canal Company.

Coal mined and forwarded by the Delaware and Hudson Canal Company for the week ending Saturday, July 5, 1873.

	WEEK.	SEASON.
By Delaware and Hudson Canal	39,817	554,072
By Railroad, East	6,780	201,664
" West	9,255	235,980
" South	719	126,153
Total 1873	55,980	1,117,869
Corresponding time in 1872:		
By Delaware and Hudson Canal	32,830	524,026
By Railroad, East	9,082	335,262
" West	7,738	182 979
" South	6,060	184,664
Total	55,760	1,226,931
Decrease	109,062	

Delaware Lackawanna & Western Rail Road Company.

Coal transported on the Delaware, Lackawanna, & Western Railroad for the week ending Saturday, July 5, 1873.

	WEEK. Tons. Cwt.	YEAR. Tons. Cwt.
Shipped North	21,854 01	395,481 07
Shipped South	30,583 11	1,164,449 06
Total	52,437 12	1,159,930 13
For the Corresponding time last Year:		
Shipped North	12,582 02	339,139 04
Shipped South	35,479 00	1,102,411 16
Total	48,061 02	1,441,551 00
Increase	4,376 10	118,379 13
Decrease		

Report of Coal Transported over the Lehigh Canal

For the week ending July 4, 1873

REGIONS SHIPPED FROM	TIDE tons. ct.	LOCAL tons. ct.	TL WEEK tons cwt	TL. DATE tons. cwt.
Mauch Chunk Region	2,748 60	2,837 06	5 585 06	10,'50 00
Mauch Chunk Region Hazardville	1,003 11	330 15	1,453 06	4,165 00
Beaver Meadow Region	385 17	1,3?1 13	1.768 00	40.714 07
Mahanoy Region	297 15	570 19	868 14	6,681 15
Hazleton Region	672 19	2,592 18	3,2 5 17	25,398 06
Upper Lehigh Region		489 02	489 02	10,568 14
Wyoming Region	192 15	485 17	678 12	40,197 06
Wyoming Region, Hazardville	91 16		91 16	91 16
Total	5,451 03	8,784 10	14 140 13	257,867 06
Previously reported	90,776 17	152949 16	243,726 13	
Total to date	96,229 00	161638 03	257,867 06	
Corresponding week last year	112163 01	178553 10	290,7?1 10	
Increase				
Decrease	15,939 00	16,915 04	32,854 04	

DISTRIBUTION.	WEEK 1873.	WEEK 1872.	YEAR. 1873.	YEAR. 1872.
Consumed on line of Lehigh Canal	1,057 01	1,906 07	24.949 01	30.960 01
Passed into Morris Canal to Tidal Points		64 17	848 13	1,925 13
Passed into Morris Canal to Local Points	735 09	871 14	10,148 13	8,015 02
Passed into Del. & Rar. Canal to Tidal Points	5,452 03	7,509 01	95,380 07	110,243 07
Passed into Del & Rar. Canal to Local Points	95 10	91 16	4 828 08	6,832 03
Consumed on line Delaware Div. Canal	691 19	700 08	12,413 12	17,756 08
Passed through to Bristol	6.078 11	9,106 14	109,298 08	114,939 16
	14,140 13	20 252 27	257867 06	290,721 10

Report of Coal Transported over Central R. R. of N. J. (Lehigh and Susq. Div.)

Week ending July 5—Compared with same time last year

REGION SHIPPED FROM.	TIDE. tons ct.	LOCAL. tons ct.	CANAL. tons ct.	TL WEEK tons cwt.	TL. DATE tons. cwt.
Wyoming	17432 05	3705 11	311 17	2'329 14	90 077 03
Upper Lehigh	1.5 10	2723 11	704 15	3513 17	101654 7
Beaver Meadow	6725 02	601 19	303 02	7630 03	12 3320 07
Hazleton		80 18	325 17	3?06 15	81191 06
Mauch Chunk	627 03	2852 06	6016 15	9336 04	2.6523 13
Total	24910 00	9834 06	10592 07	45336 13	1,47826 15
Prev'ly reported	6?7362 14	518911 19	2?3715 09	1445490 02	
Total to date	712272 14	528746 03	229907 16	1470826 15	
Same time 1872	596433 06	402 58 09	179302 15	1178.54 00	
Increase	115839 08	126087 16	50545 11	292472 15	
Decrease					

DISTRIBUTION.	WEEK 1873.	WEEK 1872.	YEAR 1873	YEAR 1872.
Forwarded East by Rail to Tidal points	24910 06	15951 15	712772 14	595433 06
Forwarded East by Rail to Local points	8629 12	2686 04	2 5166 06	189?3 08
Forwarded East by Rail use Central Division	1524 03	826 11	46215 09	39385 11
Forwarded East by Rail use L. C. S.	116 05	114 16	6402 12	4453 04
Delivered at and above Mauch Chunk	1139 05	577 16	40354 18	27674 18
Delivered at Coalport & Hazard for Canal	10737 04	11278 13	260341 02	204752 01
Delivered to L. V. R. R. at Packerton	96 04	93 02	14671 07	7947 04
Delivered to L. V. R. Rd at Sugar Notch	1184 00		52474 11	
Delivered to L. & B. R. R. at Plymouth Bridge		3423 01	112527 06	108524 08
Total	45316 13	34951 15	1470826 15	1178354 00

Report of Coal Transported over Lehigh Valley Railroad

Report of coal tonnage for the week ending July 5, 1873, with Totals to date, compared with same time last year.

WHERE SHIPPED FROM.	WEEK. Tons. Cwt.	TOTAL Tons. Cwt.
Total Wyoming	15,'61 17	469,839 10
" Hazleton	38,6?5 10	1,175,918 07
" Upper Lehigh	53 00	2,018 03
" Beaver Meadow	9,805 15	373,188 13
" Mahanoy	9,302 06	252,392 01
" Mauch Chunk	....	2,289 04
Total	73,017 08	2,275,675 18
Same time last year	66,700 13	2,203,181 12
Increase	6,316 15	72,494 06
Decrease	.....	.....
Forwarded East from Mauch Chunk by rail	57,990 08	1,8 5,221 10
Same time last year	49,796 03	1,778,08. 00
Increase	8,2?3 05	27,140 10
Decrease		

DISTRIBUTED AS FOLLOWS.

Local East of Mauch Chunk	759 15	45,270 19
Forwarded East for use L. V. R.	568 07	31,657 09
Delivered to Furnaces and Manufacturing Companies	9,?07 09	410,748 06
Delivered to Cat & Fog. R. R.	83 12	3,460 14
" " East Penn R. R.	94 17	6,225 14
" " North Pennsylvania Railroad	5,2?6 17	185,857 01
" " Port Del.	4,25? 16	87,902 04
" " East Amboy Railroad		
" " Morris and Essex Railroad	4,1?6 09	169,061 01
" " Bel. Del Railroad	2?,931 11	137,812 08
" " Central Railroad	9,709 04	327,225 14
Delivered at and above Mauch Chunk for use of L. V. R. R.	894 12	4?,909 01
To P. & N. Y. & R.	8,019 16	238,958 18
To North'n Central R. R.	598 01	9,143 03
To D. H. & W. R. R.	79 12	19,965 18
To L. & S. R. R. at Packerton for rail		7,353 14
To Individuals at Mauch Chunk		1,721 17
To Individuals above Mauch Chunk	224 07	9,048 01
To L. & S. R. R., at Penn Hav., for railroad		1 541 10
Do. for canal	3,205 17	75,398 06
To Lehigh Canal Mauch Chunk	1,844 15	28,544 05
To Catawissa Railroad		50 00
To L. & B. R. R. at Lack. June	151 00	39,793 14
Total	73,017 08	2,275,675 18

Penn. and N. Y. R. R.—Coxton, Pa.

Coal tonnage for week ending July 5, 1873.

	Week. Tons.	Cwt.	Total. Tons.	Cwt.
Anthracite received:				
From Lehigh Valley R. R.	8,019	16	238,958	10
" Lack. & B. R. R.	26	14	16,312	12
" Pleasant Valley R. R.	2,500	06	96,492	13
" Sul. & Erie R. R.	238	06	20,087	08
Total	10,785	02	371,761	11
Same time last year	10,546	14	330,461	14
Increase	238	88	41,299	17
Decrease				
Distributed:				
To Lehigh Valley R. R.	948	03	22,026	15
To Lack. & B. R. R.	58	06	718	00
To S. Central R. R.	2,240	19	86,903	19
To Ithaca & A. R. R.	4,050	03	62,852	05
To Erie R. W. Pockets for shipm't.	2,191	10	130,911	16
To Erie Railway, Watkins direct.	692	11	14,439	19
To individuals on line of road	60	05	17,565	09
To points at & above Coxton for use of Co	370	02	15,559	08
To points between Waverley and Elmira	172	08	33,784	00
Total	10,785	02	371,761	11
Bituminous received from BARCLAY R. R.				
Shipped north from Towanda	6,020	14	167,901	11
Shipped south from Towanda	75	05	1,193	19
Northern Central R. R.	46	00	91	14
Total	6,141	19	169,187	04
Same time last year	5,499	14	197,629	07
Increase	642	05		
Decrease			28,442	03
Distributed:				
To Erie Railway	5471	13	148,240	00
To So. Central R. R.	484	12	19,407	17
To Ithaca Valley R. R.	64	09	213	17
Lehigh Valley, R. R.	6	00	586	16
To individuals on line of Railroad.	115	05	620	10
To points on line of road for use of Company		....	118	04
Total	6,141	19	169,187	04
Grand totals transported				
Anthracite	10 785	02	371,761	11
Bituminous	6,141	19	169,187	04
Total	16,927	01	540,948	15
Same time last year	16,046	08	528,091	01
Increase	880	13	12,857	14
Decrease				

Statement of Coal Transported over Cumberland and Pennsylvania Railroad

During the week ending Saturday July 5, and during the year 1873, compared with the corresponding period of 1872.

WEEK.

	C. & O. C'l Tons. Cwt	B. & O. R. R. Tons. Cwt.	Pa. S. Line Tons. Cwt	Total. Tons. Cwt.
1873	17,2 3 08	24,313 13	865 18	42,412 19
1872	15,235 19	23,707 12	....	38,943 11
Increase	1,967 09	606 01	865 18	3,469 08
Decrease	....	....	....	....

YEAR.

1873	281,751 05	701,920 02	43,332 13	1,026,404 00
1872	285 3 4 05	624,462 18	....	969,847 03
Increase		77,457 04	43,332 13	116,556 17
Decrease	4,2 3 00	....	....	....

Cumberland Branch R. R.

WEEK.

	To C. & O. Canal. Tons.	Cwt.	To B. & O. R. R. Co Tons.	Cwt.	Total. Tons.	Cwt.
1873	4,396 03		617 11		5,013 14	
1872	3,772 15		476 05		4,249 00	
Increase	613 08		141 06		.....	
Decrease			.....		754 14	

YEAR.

1873	47,304 05	56,005 16	103,310 01
1872	92,214 13	9 271 13	101,516 06
Increase		46,734 03	1,793 15
Dec ea-e	44,9 1 03		

Pennsylvania Coal Company.

Shipments of Pittston Coal for the week ending July 5, 1873.

	1873. WEEK.	1873. YEAR.	1872. WEEK.	1872. YEAR.
By Railway	26,762 08	588,572 17	19,546 00	586,666 12
" Canal	252 16	3,341 05		2,034 10
	27,015 04	591,914 02	19,546 00	588,701 02
Decrease, 1873	3,213 00			

Prices of Coal by the Cargo.

(CORRECTED WEEKLY.)

	AT NEW YORK. July 3 R. A.	W. A	AT PHILADELPHIA. July 3. R. A.	W. A.
SCHUYLKILL.				
Lump	$- —	$5 45	— —	4 10
Steamer	— —	5 45	— —	4 10
Broken	5 71	5 45	4 35	4 10
Egg	5 85	5 60	4 50	4 25
Stove	6 05	5 75	4 70	4 40
Chestnut	5 20	5 95	3 85	3 60
Pea	— —	— —	— —	— —
LEHIGH.				
Freight to New York 50 cents.			— —	— —
Lump, (on board)	— —	— —	— —	—
Broken	— —	— —	— —	— —
Egg	— —	— —	— —	—
Stove	— —	— —	— —	— —
Chestnut	— —	— —	— —	—
Pea	— —	— —	— —	—
SPECIAL COALS.*				
Honey Brook, Le'h W. A.	4 85@5 55		— —	— —
Spring Mountain " "	5 60@- —		— —	— —
Sugar Loaf " "	4 90@5 70		— —	— —
Room Run " "	4 70@5 55		— —	— —
Hill & Harris " "	4 70@5 60		— —	— —
Shamokin " "	4 70@5 60		— —	— —
Lykens Valley " "	4 85@6 10		— —	— —
Broad Top " "	6 60@- 10		5 35	— —

Company Coals.

July, 1873.

	L.	Bkr.	Ora.	Egg.	Sto.	Chest
*Scranton at E. Port	—	—	—	—	—	—
Pittston at Newburgh	4 70	4 70	4 80	4 90	5 20	4 70
*Lackawana at Weehawken	4 70	4 70	4 90	5 15	5 00	4 70
Wilk'b're at Hoboken	4 65	4 75	4 90	5 00	5 20	4 65
Old Co. Lehigh at Pt. John'n	5 70	—	5 55	5 45	5 60	4 90
New York Coal Exchange	5 55	—	5 20	5 40	5 55	4 85

For freights to different points see "Freights."

*To contractors only.

Prices at Baltimore—July, 1873.

Wholesale Prices to Trade.

Wilkesbarre, by cargo or car load	$5 75@6 00
Pittston and Plymouth, do	5 50@5 75
Shamokin Red or White Ash, do	5 50@5 75
*Lykens Valley Red Ash, do	....@5 80
By retail, all kinds per ton of 2,240 lbs	7 50@8 00
*George's Creek and Cumberland f. o. b. at Locust Point for cargoes	....@5 00
Fairmont and Clarksburg gas f. o. b. at L. Point	6 50
Kanawha Cannel, coarse	@12 00

* Freight to New York $2 15.

BITUMINOUS COALS.

Kittaning Coal Co.'s Phœnix Vein, f. o. b. at Phila	$
Lemon " " "	
Cumberland Vein Coal	....
Tyrconnel f. o. b.	$7 00

Prices at Georgetown, D.C., and Alexandria, Va.

July, 1873.

George's Creek and Cumberland f. o. b. for shipping $5 00@- —

Prices at Havre de Grace, Md.

July, 1873.

Wilkesbarre and other White Ash for Cargoes	$ @....
Lykens Valley	@....
Shamokin Red or White Ash	....

Bituminous Coals (Cumberland).

Georgetown, F. o. b.	$4 60
Baltimore "	5 00
New York "	7 25
South Amboy "	7 50

Prices of Foreign Coals.

July, 1873.

Duty 75 c. per ton.

Corrected weekly by ALFRED PARMELE, No. 32 Pine street, N. Y.

Liverpool Gas Coking	— —@— —
" " Cannel	17 00@— —
" House "	20 00 @22 00
" Orrel	20 00@— —

Per ton 2,240 lbs., ex-ship.

PRICES FROM YARD.

Liverpool House Orrel, screened	$20 00@22 00
" Cannel, "	22 00 @25 00

Per ton 2,000 lbs. delivered.

Prices of Gas Coals.

July, 1873.

PROVINCIAL.

Corrected weekly by Louis J. Belloni, Jr., 41-43 Pine st., N. Y

	Coarse	Slack
Block House, f. o. b. at Cow Bay	$2 50	$1 25
Gowrie	2 00	0 00

Corrected by Bird, Perkins & Job, 27 South street.

	Coarse.	Culm of Coal.
Pictou, nett	$3 00	1 50
Sydney	3 25	1 00
Lingan	2 75	1 00
Caledonia	2 75	1 25

A discount from the prices of the coarse Coal on purchase of 5000 tons and upwards. Duty on all slack coal or Culm: 40c. per ton of 28 bushels, 80 pounds to the bushel. On all bituminous coal or shale: 75 cents per ton of 28 bushels.

AMERICAN.	Nominal quo Currency.
Westmoreland, f. o. b.	$6 00 @7 00
Fairmount Gas Coal Co. of N. Y. "	6 50 @7 00
Despard Coal Co. "	6 50 @7 50
Penn. "	6 50 @7 00
Newburg Orrel Gas "	6 50 @7 00
West Fairmount Gas Coal "	6 50 @7 00
Redbank Cannel, at Pa "	12 00 @0 00
AT PHILADELPHIA.	
Westmoreland "	7 50 @0 00

Rates of Transportation to Tide Water.

BY RAILROAD.

TO PORT RICHMOND, PHILADELPHIA.

Philadelphia and Reading Railroad, from Schuylkill Haven Lump and St., net, $1 60; Br., Egg and Ch., $1 65; Stove, $1 75 Shipping at Pt. R., 20c., for use at Phil., $2 18 from Pt. Carbon,

MAUCH CHUNK TO ELIZABETHPORT.

L. V. Railroad from Mauch Chunk to Phillipsburgh	$0 72
C. R. R., N. J., Phillipsburgh to Elizabethport	06
Shipping expenses at Elizabethport	25
Wharfage	10
Total	$2 23

MAUCH CHUNK TO PORT JOHNSTON.

L. V. R. R., or L. & S. R. R. from M. C. to Phillipsb'g	$0 72
C. R. R., of N. J., Phillipsburgh to Pt. Johnson	1 06
Shipping expenses	25
Wharfage	10
Total	$2 23

TO HOBOKEN

L. V. R. R., Mauch Chunk to Phillipsburgh	72
Morris & Essex R. R. Phillipsburgh to Hoboken	1 06
Shipping expenses	25
Wharfage	00
Total	$2 23

TO SOUTH AMBOY.

L. V. R. R.	72
R. & D. R. R. / Cam. & Am. R. R.	1
Shipping Expenses	35
Total	$2 23

PENN HAVEN TO ELIZABETHPORT.

L. V. R. R. Penn Haven to Phillipsburgh	84
C. RR. of N. J. Phillipsburgh to Elizabethport	1 06
Shipping expenses	15
Wharfage	20
Total	$2 35

Freights.—July, 1873

TO EASTERN PORTS.	Cumberland. From Georgetown.	Cumberland. From Baltimore	Anthracite. From Philadelphia.	Anthracite. From Elizabethport, Port Johnston, Port Caledonia, and Hoboken.	Anthracite. From Newburgh.	Anthracite. From Rondout.
Amesbury	3 75	—		—	—	—
Bangor	3 25	—		2 00	—	—
Bath	3 20	3 00		2 20	—	—
Boston	3 00	3 00		2 00*	2 25	2 15
Bridgeport	2 50	3 00		1 00	1 20	1 25
Bristol	—	—		1 40	1 60	1 65
Cohasset Narrows	3 25	—		—	—	—
Derby	3 00	—		1 .5†	—	—
Dighton	2 70	—		—	—	—
East Cambridge	2 75	—		2 00	—	—
Fall River	2 55	2 75		1 40	1 60	1 65
Hackensack	—	—		—	—	—
Hartford	3 10	3 25		1 50	—	1 75
Hoboken	2 15	—		50	—	65
Jersey City	2 15	—		50	—	65
Lynn	—	—		—	—	—
Middletown	—	—		1 25	—	1 50
Mystic	—	—		1 25	—	—
New Bedford	2 60	2 85		1 50	—	1 70
Newburyport	3 25	3 25		2 15	—	2 20
New Haven	2 50	2 60		1 00	1 20	1 25
New London	2 50	2 65		1 25	1 40	1 45
Newport	2 60	—		1 40	1 60	1 60
New York	2 25	2 15		50	—	65
Norwalk	2 75	2 50		1 00	—	1 25
Norwich	2 75	2 75		1 30	1 50	1 65
Pawtucket	1 80	3 07		1 50‡	—	—
Portland	3 00	3 00		1 90	—	—
Portsmouth, N. H	3 25	3 25		2 10	—	2 25
Providence	2 50	2 7		1 40	1 60	1 65
Rockport	—	—		—	—	—
Saco	—	—		—	—	—
Sag Harbor	—	—		1 25	—	—
Salem	3 20	3 25		2 00	—	2 15
Stamford	—	—		1 00	1 20	1 25
Stonington	—	—		1 25	—	—
Taunton	—	—		1 90	—	—
Warren	—	—		1 40	—	—
TO RIVER PORTS						
Albany	3 50					55
Catskill	—					50
Cocksackie	—					50
Coeyman's	—					65
Cold Spring	—					20
Fishkill	—					20
Haverstraw	—					40
Hudson	2 50					40
New York vessels	2 00					65
Nyack	—					45
Poughkeepsie	2 4					30
Rhinebeck	—					30
Rondout	—					40
Saugerties	—					50
Sing Sing	—					55
Stuyvesant	—					50
Tarrytown	—					60
Troy	—					20
West Point	—					50
Yonkers	—					

+3 c. per ton per bridge extra.
† New Haven rate and towing 25 c. extra per ton.
‡ Towing from Providence and return, extra.
§ And towing.

St. Thomas	$- — Gold
Martinique	— — "
Demerara	— — "
New Orleans	— — "
Mobile	— — "

Foreign and Provincial Freight

July, 1873.

Foreign.

Newcastle and Ports on Tyne, per keel of 21 1-5 tons £ Liverpool, 5 per cent primage

TO NEW YORK.

Provincial	
Sydney	$3 75
Lingan	4 00
Cow Bay	4 00
Port Caledonia	4 00
Little Glace Bay	4 00

TO BOSTON.

Sydney	3 50
Lingan	3 60
Cow Bay	3 50
Port Caledonia	3 50
Little Glace Bay	3 50

TO MONTREAL.

Caledonia	3 75 gold.

TO CUBA.

Caledonia	6 50 gold.

MARKET REVIEW.

NEW YORK, July 9, 1873.

IRON—Business in Scotch Pig, with the exception of the hand-to-mouth trade that has been going on for some time past, is very dull, and no increase of moment is looked for in the near future; our quotations are to a great extent nominal, and for prompt cash lower rates would most likely be accepted; the stock of Eglinton is now small, and we quote for small lots from yard $43@$44, while no large parcels, we believe, are to be had; Glengarnock is offered to arrive at $43, and on the spot may be quoted $43@44. American Pig shows no improvement; as the season advances stocks probably will accumulate and lower prices are likely to rule, though at present some companies are asking very full figures, and do not care to sell. New English and American Rails may be called dull; the only sale of old is 300 tons Bridge at Philadelphia at a private price. Scrap is without movement. Manufactured continues depressed, but prices are nominally steady. We note a sale of 100 packs Russia Sheet (No. 10 and 11) at 18 cents gold.

LEAD—Ordinary Foreign Pig is generally held at 6¼ cents gold, but we note the sale of 100 tons Spanish at 6½ gold. Of Domestic, we note the sale of 50 tons at 6¼ cents gold. Bar 9¼ cents, Sheet and Pipe 10½, and Tin-lined Pipe, 16½, all less ten per cent. to the Trade.

Withdrawals from bond for consumption 2d, 3d, 5th and 7th July—

Lead, France.....pigs.395

COPPER—New Sheating is steady at 38 cents, and Bolts and Braziers 40; Bronze and Yellow Metal Sheating 27, and Y. M. Bolts 32, net cash. Ingot Copper is very dull, and in the absence of business, prices are nominal, but still tend in buyers' favor; Lake is offered at 28@28½ cents.

Witndrawals from bond for consumption 2d, 3d, 5th and 7th July—

Copper, Liverpool.....casks.7

SPELTER—Is dull. Silesian may be quoted nominally 7½@7¾ cents gold, as to brand.

Withdrawals from bond for consumption 2d, 3d, 5th, and 7th July—

Spelter, Germany.....plates.3,982

REGULUS ANTIMONY—Is held at 13¾ cents gold, from first hands, with sales of 8 casks.

STEEL—English Cast Steel, both Sheet and Bar, especially of best quality, is scarce and wanted, but other descriptions are neglected, the American supplying the market at less than the cost of English.

TIN—Cables have been received from England advising an advance on Pig of 10s., and the disposition to buy, before noticed, has been quickened. The business has been large at about the prices previously current, but at the close there was an improved tone, the tendency being in sellers favor; the transactions embrace 150 slabs Straits at 31½ cents, 30 days; 1000 do., in Boston, to come here, 31½; 4@5000 do., also there, on private terms, but at full rates; 75 do. Banca, 36; 5 tons English, 30¼; 20 do., to arrive, 29¾, all gold; and 10 tons English, and 200 slabs Billiton, on private terms. For Straits, 31¾ cents is now asked, English L. & F., 30@30¼, and Banca 36, gold. Plates have been quiet; we note sales 500 bxs. Charcoal Tin at $11,25; 500 do. good brands, $11,62½; and 250 do. Charcoal Terne, $10 gold.

Withdrawals from bond for consumption 2d, 3d, 5th and 7th July—

Tin from England.....bxs.200

ZINC—Mosselman Sheet has been very quiet, ever since the last advance was made, and is held nominally at 8½@9 for Am. oxide, and 9¼@9½ for French. Manganese 4¼@5.

Messrs. BIGELOW & JOHNSTON review the market for the month of June as follows:

NEW RAILS.

IRON—Foreign, $65@68, gold; *American, $75@80, currency; Import at New York this month, 4,568 tons; previously since January 1, 34,249 tons; total to date, 38,817 tons; †same time, 1872, 88,491 tons; same time, 1871, 96,971 tons.

STEEL—Foreign, $108@112, gold; American, $120@125, currency; Import at New York this month, 7,635 tons; previously since January 1, 34,882 tons; total to date, 42,517 tons.

OLD RAILS.

Double Heads, $51@52, currency; T or Flange, $49@50, currency; U or Bridge, nominal; Import at New York this month, 1,867 tons; previously since January 1, 6,687 tons; total to date, 8,554 tons; same time, 1872, 27,534 tons; same time, 1871, 19,887 tons.

SCRAP IRON.

No. 1 Wrought, $45@48.

PIG IRON.

American Forge, $34@36, currency; No. 1 Foundry, $44@48 currency; No. 2 Foundry, $42@46 currency; Scotch No. 1 Foundry, $41½@47 currency; Import of Foreign this month, 6,874 tons; previously since January 1, 28,368 tons; total to date, 35,242 tons; same time, 1872, 49,856 tons; same time, 1871, 43,178 tons.

NEW RAILS—With the exception of a sale of about 1500 tons for New Orleans delivery, on private terms, there has been little or no change in the position of our market for Foreign Rails. Prices are if anything rather weaker, and some holders evince considerable anxiety to realize. Of American Rails a few thousand tons were reported as sold on private terms, but apart from this the trade remains inanimate. We close the month with some little improvement in the inquiry, though there is a marked absence of cash buyers.

OLD RAILS—There has been scarcely enough done during the month to establish a market, and we therefore renew our former quotations, remarking however, that they are altogether nominal. The arrivals are again on a limited scale, and have mostly gone into consumption on contracts made some time ago.

SCRAP IRON—Dull and irregular.

PIG IRON—In American the trade is limited to immediate requirements, and prices, though maintained nominally at recent rates, particularly by those Furnaces that sold well up early in the season, have actually declined $2@3 per ton. Good No. 1 cannow be had at $45. Scotch Pig has been freely supplied by the various steamship lines at gradually receding prices. In Glasgow the market has also steadily declined, the prices there on 19th ult. being as follows: Coltness and Gartsherrie 120, Glengarnock 117, Eglinton 112, fob, and a positive offer of even less would buy. The low rates ruling here have drawn out considerable inquiry, and a good deal of iron has been disposed of. Of the arrivals this month about 3,000 tons were Scotch, the balance being Bessemer and Yorkshire iron.

* These prices represent as nearly as possible the range, according to location of mill.

† These figures included Steel.

METALS.

NEW YORK, July 9, 1873.

IRON.—Duty: Bars, 1 to 1½ cents ℔ lb; Railroad, 70 cents ℔ 10 lbs.; Boiler and Plate, 1½ cents ℔ lb; Sheet, Band, Hoop, and Scroll, 1¼ to 1¾ cents ℔ lb; Pig, $7 ℔ ton; Polished Sheet, 3 cts. ℔ lb; Galvanized 2½; Scrap Cast, $6; Scrap Wrought, $8 per ton. All less 10 per cent. No Bar Iron to pay a less duty than 35 per cent. ad val.

	Store Prices.
Pig, Scotch—Coltness ℔ ton	52 00@53 00
Gartsherrie	— —@— —
Glengarnock	43 00@44 00
Eglinton	43 00@— —
Pig, American, No. 1	45 00@48 00
Pig, American, No. 2	41 00@44 00
Pig, American, Forge	35 00@— —
Bar Refined, English and American	00 00@— —
Bar Swedes, assorted sizes 'gold	— —@137 50

	Store Prices, Cash.
Bar, Swedes, 1¼ to 5 x ⅜ & ⅞ 2 sq. & 6 to 12 x ⅜ & ¼	175 00@185 00
Bar, Refined, ¾ to 2 in. rd. & sq. 1 to 6 in. x ⅜ to 1 in.	92 50@ 95 00
Bar, Refined, 1¼ to 6 by ¼	97 50@100 00
Bar, Refined, 2½ to 2⅞ round 1 & 1¼ by ¼ & 5-16	100 00@102 50
Large Rounds	104 50@117 50
Scroll	112 50@145 00
Ovals and half-round	120 00@140 00
Band	110 00@112 50
Horse Shoe	— —@122 50
Rods, ⅜ to 3-16 inch	97 50@140 00
Hoop	100 00@170 00
Nailrod	9¼@ 9¾
Sheet, Russia, as to assortment (gold)	16½@ 18
Sheet, Singles, D. and T. Common	—6½@— 7¼
Sheet, D. and T. Charcoal	—7¼@— 8½
Sheet, Galv'd, list 10 per cent, discount	— —@— —
Rails, English (gold), ℔ ton	67 50@ — —
Rails, American, at Works in Pennsylvania, currency	77 50@ — —

COPPER.—Duty: Pig, Bar, and Ingot, 5; old Copper 4 cents ℔ lb; Manufactured, 45 per cent. ad val.

	All Cash.
Copper, New Sheathing, ℔ lb	— @— 38
Copper Bolts	— @— 40
Copper Braziers, 16oz. and over	— @— 40
Copper Nails	— @— 45
Copper, Old Sheathing, &c. mixed lots	26 @— 27
Copper, Old, for chemical purposes, 14@16 oz	— @— —
Copper, American Ingot	24 @— 28½
Copper English Pig	— @— 28
Yellow Metal, New Sheathing & Bronze	— @— 27
Yellow Metal Bolts	— @— 32
Yellow Metal Nails, Sheathing and Slat'g	27 @— 30

LEAD.—Duty: Pig, $2 ℔ 100 lbs.; old Lead, 1½ cents ℔ lb

Pipe and Sheet, 2¼ cents ℔ lb.	
Galena, ℔ 100 lbs	$6 50 @6 75
Spanish (gold)	6 50 @6 75
German, do.	6 62½@7 00
English do.	6 62½@7 00
Domestic do.	6 12½@6 25
Foreign, Refined	7 25 @— —
Bar (net)	9 25 @— —
Pipe (net)	— — @10 50
Sheet	— — @10 50

STEEL.—Duty: Bars and ingots, valued at 7 cents ℔ lb or under 2¼ cents; over 7 cents and not above 11, 3 cents ℔ lb; over 11 cents, 3¾ cents ℔ lb, and 10 ℔ cent ad val. Store prices.

English Cast (2d and 1st quality) ℔ lb	— 18¾@— 23
English Spring (2d and 1st quality)	— 9½@— 10½
English Blister (2d and 1st quality)	— 14 @— 18½
English Machinery	— 14½@— —
English German (2d an 1st quality)	— 12½@— 14½
American Blister "Black Diamond"	— — @— 11½
American, Cast, Tool do.	— — @— 17
American, Spring, do.	— — @— 11
American Machinery do.	— 11½@— 12
American German, do	— 9 @— —

TIN.—Duty: Pig, Bars, and Blocks, 15 ℔ cent. ad val.; Plate and Sheets and Terne Plates, 25 ℔ cent.; Roofing 25. ad val.

	Gold ℔ lb.
Banca	36 @—
Straits	31¾@—
English	31@30½

PLATES.

Fair to Good Brands.	Gold.	Currency
I. C. Charcoal, ℔ box	$11 25 @11 50	$13 25 @13 75
I. C. Coke	9 00 @ 9 50	10 75 @11 25
Coke Terne	8 00 @ 9 00	9 50 @10 50
Charcoal Terne	10 00 @10 50	11 75 @12 25

SPELTER—Duty: In Pigs, Bars & Plates, $1.50 p. 100 lb

Plates, Foreign (gold) p. 100 lb.	7 50 @—7 75
Plates, Domestic p. lb.	8½@—11

ZINC—Duty: Pig or Block, $1.50 per 100 lb.; Sheet 2½c. per lb

Sheet ..... per lb.—10½@11

San Francisco Stock Market.

BY TELEGRAPH.

NEW YORK, July 9, 1873.

The following from the San Francisco Stock Board is dated the 8th inst. Savage has advanced $16, with which exception the list has scarcely changed from our figures given a week ago. The regular monthly dividend of Belcher has been declared payable on the 10th inst.; the amount is $8 per share, a falling off of $2 per share as compared with the June dividend.

	July 9.		
Savage	160	—	—
Crown Point	100	—	—
Yellow Jacket	63	—	—
Kentuck, "New Issue"	9¼	—	—
Chollar Potosi	56	—	—
Gould & Curry "New Issue"	13¼	—	—
Belcher "New Issue"	95	—	—
Imperial	6¼	—	—
Raymond & Ely	6	—	—
Meadow Valley	21¾	—	—
Eureka G. V.	—	—	—
Ophir	—	—	—
Hale and Norcross	—	—	—

American Institute of Mining Engineers.

OFFICIAL BULLETIN.

Announcements to Members and Associates.

I. The ENGINEERING AND MINING JOURNAL, which is the Organ of the Institute, and contains its proceedings, transactions and notices of meetings, will be sent to each Member and Associate on the payment of his annual dues. Back numbers cannot, as a rule, be sent.

II. Dues are payable in advance at the annual (May) meeting. Remittances should be made, as far as possible, by P. O. Order, payable to the Secretary.

III. The first volume of Transactions of the Institute is in course of preparation and will be sent, as soon as issued, to all members not in arrears.

IV. General meetings are held on the fourth Tuesday of February, May and October. Authors of papers are requested to notify the Secretary, in advance of meetings, of the subject and length of their papers.

THOMAS M. DROWN, Secretary.

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ROSSITER W. RAYMOND, Ph. D.
JOHN A. CHURCH, E. M. Editors.

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IT is not hard to understand why mining ventures in Mexico are hazardous, when we are told that claims for damages by Mexican raids on Texas soil, to the amount of $27,859,363, were presented to the Congressional Commission. The lack of ability to maintain the laws, which this enormous claim indicates, is equally well demonstrated in the inability of a successful miner from another country to maintain himself in Mexico. The laws are admirable, the mines rich, and, for the most part, they can be cheaply worked; but whoever puts energy and skill enough into the task to make himself sure of success is pretty certain to bring upon himself all the evils which unscrupulous men, supported by venal judges, can inflict upon the miner. The cheapness of labor and of the mines themselves would attract capital to Mexico rapidly, were it not that the history of mining enterprise there is a warning to every sensible man.

WE are glad to see that one New York paper—the *Times*—has passed by the usual style of newspapers when dealing with the coal question, and has endeavored to make its readers believe that changes have come upon the trade in coal which are not to be disregarded. It has been the fashion for some months past to announce with the results of each auction sale, that a combination of soulless capitalists were bleeding the poor. The daily press claims to be the only true guide of mankind in these latter days, and we never have known a newspaper to acknowledge ignorance on any subject. But so far as we have observed their course during the advance in coal, those who look upon them as oracles will have long bills to pay for coal in the fall. They have usually represented the combination of great companies as a grinding monopoly with no reason for its existence but the greed of its members. It is a thankless task to say a word for any monopoly, and the daily press seems to fear nothing more than to be caught telling the truth about that class which it dubs, "the wealthy and aristocratic," but which, in business circles at least, is composed of the anxious and thoughtful men who are the managers and fosterers of a great part of American industrial activity. We have, ourselves, endeavored to treat this question from the first as one which had another basis than mere personal advantage, and the daily papers could well follow our example. They reach a much larger circle of readers who belong, too, to a class more dependant upon their newspaper for guidance than our own readers, and they ought to be safer guides in these matters than they are.

Friendly Criticisms.

THIS is the eighth year of the collection of mining statistics, and the sixth year of the incumbency of the present Commissioner. One would think that time enough has elapsed to permit a faint conception of the nature of the work, and the methods of its prosecution, to dawn upon the minds of the residents of the mining districts, and to be reflected in the columns of their local journals. Yet the crude and unreasonable notion still seems to maintain itself in many quarters, that the duty of the Commissioner is to collect in person all the information which he publishes, and that if he fails to visit a district, or to stay there as long as the local thinks proper, that district is manifestly neglected.

The other day, Mr. RAYMOND, on his way home from New Mexico, spent a few hours in Georgetown, Colorado, and was very glad of the opportunity to meet as many of his personal and professional friends as he could find in the brief period of his visit. That the editor of the Georgetown *Miner* was not among the number is matter for regret. It is likewise matter for regret that the gentleman referred to, chose to consider this flying trip as the whole of the official work in Colorado, and to allude ironically to "the very full and interesting report" which must result.

In reply to a protest, from a correspondent, the editor said, in his next number:

"All right, dear sir. Your opinion is entirely welcome, but fails to change our own. We believe that there is no appropriation made by congress for mines "east of the Rocky Mountains," and consequently we have no right to expect anything from the commissioner. He came here on private business, it is true, but he also came on business connected with his report for 1873, and those of previous years have so greatly disappointed and misrepresented us that it is simply discouraging to see an official in his capacity pass through our country in such a manner. He has it in his power to do us a great deal of harm or a great deal of good. If he cannot give that attention to the mines that is needed to secure the latter, surely it were better to leave the matter alone, and not skim over the great industry of Colorado with a two or three days' visit, that cannot but lead to false impressions."

It is an old tradition with the Georgetown *Miner* that Mr. RAYMOND'S reports have "misrepresented" the Territory of Colorado. It made this charge in its usual dashing manner, *before Mr. Raymond had published a single report on Colorado;* and, so far as we know, it offered no retraction or apology afterwards, but continued from year to year to grumble and complain, without the slightest foundation in fact. We challenge it to-day to furnish any proof whatever of the misrepresentation to which it is so fond of alluding. That there has been "disappointment," we are quite ready to admit. For several years, anything short of blind and indiscriminate puffing was a keen disappointment to many persons, who would have liked to bolster up with official documents their schemes of mining speculation. But the actual industry, product, and ascertained resources of Colorado have been fairly represented in these reports, and the suggestions and advice contained in them, though not always palatable at the time, are now acknowledged to have been judicious.

The chapter on Colorado in the last report of the Commissioner (now in manuscript at Washington, awaiting publication) is the product of the labors of a number of competent experts, each of whom spent in the Territory, during 1872, not a few hours, but 365 days, 5 hours, 48 minutes and 46.04 seconds. If the Georgetown *Miner* can get more than that out of a year, it will render a boon to the Commissioner by communicating its method; since he finds the astronomical obstacles to his work and that of his assistants the most troublesome of all.

The *Miner* is quite right in saying that no appropriation is made for statistics east of the Rocky Mountains, and that, strictly speaking, Colorado need not be considered as within the field of the Commissioner's operations; but it is quite mistaken in assuming that a larger appropriation would alter the length of the year, or make it possible for one man to pick up more information in a given time. The object for which the Commissioner has persistently urged a larger appropriation and an extension of his sphere of operations has been the employment of a more numerous corps of resident correspondents and assistants, and the payment of many eminent gentlemen from whose public spirit or personal friendship he has hitherto exacted gratuitous service. The appropriation this year is $15,000. If it were $25,000 for the West, or $40,000 for the whole country, according to the Commissioner's estimate, laid before the Congressional Committee, the office-work of correspondence, compilation and editing reports would be so far increased as probably to diminish the personal travelling of the Commissioner. In that case, the *Miner* might get many an item, in dull times, out of the "injustice" done to Colorado.

If we thought it would do any good, we might explain at length that Mr. RAYMOND travels in the West every year, chiefly to secure in each district the services of trustworthy assistants, and to arrange with them the plan of their work; that he visits mines, or works, or new districts, only when, by reason of some novel features, or by reason of the lack of accurate information from other sources, they seem to him to require a personal visit; that it has taken six seasons to enable him, in this partial way, to go through all the States and Territories in his field (except Arizona); that there are many important districts even yet, where he has not been able to set his foot; that his paramount duty is to prepare an annual report, as thorough and comprehensive as it can be made; that if he consulted his own comfort and pleasure, he would be very likely to spend all the time in the delightful climate and splendid scenery, and among the interesting and progressive industries of Georgetown—particularly in view of the fact that Georgetown has a first-class hotel, and that, by the use of proper means, one might get a handsome notice in the Georgetown *Miner;* but that, unfortunately for all concerned, this pretty programme is quite impracticable.

We might explain all this at length; but to what end? After the present editor of the *Miner* shall have been promoted to some higher sphere (if any such there be) there will come a young fellow in his place, who will go back on the files of the paper, when news is scarce, and fish out the same old paragraphs which have

done duty so many times. We cannot undertake to enlighten the successive generations of critics who may indulge in an occasional "stickful" of damaging severity, larded between their notices of "washerwoman wanted," and "the best plug tobacco in the world."

But may we not plaintively appeal, on behalf of the Commissioner, to some six hundred editors, in places which he has not insulted with a sixteen hours' visit (or any other kind of a visit, this year) not to come down upon him altogether, and slay him utterly? Bear in mind, gentlemen, that he is now writhing beneath the lash of the Georgetown *Miner;* nay, worse, (can it be worse?) he may be at this moment interviewing the Atlantic Ocean in the most unpleasant manner—for he sailed, last week, on his return from Colorado, upon a hasty trip to Vienna. Perhaps despair drove him to this step; perhaps the circumstance that he was instructed by his official superiors to look at mining and metallurgical novelties abroad had something to do with it. At all events, he is gone, and will not be back until September. Don't hit him too hard, unless news is very scarce! In return for this forbearance, we can assure you positively, that the field-work of his department goes on just as usual, under the arrangements perfected by him before his departure; and that even when you feel yourselves most forsaken, there is probably a "chiel amang you, takin' notes."

CORRESPONDENCE.

Bessemer Steel—An Experiment in Troy.

JOLIET, ILL., July 2, 1873.

TO THE EDITOR:

SIR—In February, 1872, at the instance of Mr. HOLLEY, and under the direction of Dr. ADOLPH SCHMIDT, the Messrs. GRISWOLD very liberally gave my plan for the substitution of a cheaper material for spiegeleisen a fair trial. This plan was the use of silicon instead of manganese for the purpose of reducing the oxides formed in the last stage of the American and English processes of "*over blowing.*" The idea was based upon the greater affinity of silicon for oxygen than iron for that element, and as affinity is so dependent upon temperature, actual experiment was necessary to determine its value. The following were among the results obtained in the two tons converted:

Charge 1899. Recarburized with 5.3 per cent. Spiegel and Franklinite
1.3 " " Pokeepsie iron
6.6

Grade III¼ ingots rolled well.

Charge 1913. Recarburized with 2.6 per cent. Pokeepsie iron
4.0 " " Spiegel and Franklinite
6.6 " "

Grade III¼ ingots rolled pretty well.

Charge 1925. Recarburized with 4.0 per cent. Pokeepsie iron
1.3 " " Spiegeleisen
1.3 " " Franklinite
6.6

Grade III ingots cracked in rolling.

Charge 1965. Recarburized with 2.6 per cent. Durham iron
2.0 " " Spiegeleisen
2.0 " " Franklinite
6.6

Grade III¼ ingots rolled well.

Pokeepsie iron is an anthracite iron, used at that time in small quantities, with Cumberland iron, in the charge for steel. It contained considerable silicon. Durham iron is made from the pure and highly siliceous magnetic ores of COOPER & HEWITT, at their furnace in Durham, Pa. The minimum of silica which they have been enabled to obtain by basic charges and comparatively cold blast, was 5.30 per cent.—the iron mixes admirably with steel scrap and cold working pig.

Unfortunately there were no analyses made of the cracking ingots, to determine the cause of their red shortness—whether due to silicon or unreduced oxides is still problematical. *As in the presence of manganese in the bath of metal, silicon would doubtless be inert,* it is important to know the *minimum* amount of manganese, and hence of spiegeleisen, necessary to perform the work of reduction. As steel would bear less of silicon than of manganese, it would be more difficult to adjust the amount of siliconized pig iron needed to reduce and recarburize than of spiegeleisen.

The grade marks are in accordance with Dr. SCHMIDT'S forge test classification, based upon the hardness and angle of fracture of an annealed and tempered piece of steel, square, and about 1-6 square inch section. Grade III corresponds to about 0.3 per cent. of carbon, and is preferred by railway companies.

Will spiegeleisen be available as long as needed? If not, are we to recur to fixed converters and "*underblowing,*" or are we to find a substitute?

Yours, R. H. TERBUNE.

Japanese Metal Work.

The New York *Times,* in an interesting account of the objects of Japanese art, now on exhibition at the Metropolitan Museum of Art in this city, gives the following description of what appears to be real skill in the treatment of metals by fire. We should say, however, that this, so far from being metallurgic art, is the art of the jeweller—a very different thing, and with a different purpose. "Next to the gold lac ware comes the copper work. There is a copper cup, the whole body of which appears to be oxydized silver, but it is impossible to detect how it is joined, and it looks like the transmutation of metals—downright alchemy in short. There are also some copper vessels beautifully enameled, not cloisonne ware, but painted in enamel. The ground is the famous turquoise blue, and this is covered with a delicate tracery of lines and flowers, so like the arabesque that the odds are the Arabs got their germ of ideas from these people. These patterns are wrought out mostly in a brilliant white, a dull red which harmonizes perfectly, a pale green, and a most superb purple, every one of which is in absolute keeping with the turquoise blue. The bronze grotesque figures, none of which are more than two inches high, and few more than one inch, deserve peculiar attention, not only for the remarkable finish of the casting, but for the wonderful color of the bronze in which the artist gets a red effect whenever he wants it. There is a grotesque of a man killing a tiger. He is seated deliberately on it, and is plunging a huge knife into the animal's throat, which rude treatment is borne with the utmost calmness. The figures are quite small, but the finish is wonderful. Another fine grotesque is a frog, with a monkey's head perched on a cockle-shell. The workman has got one color in the bronze of the shell, another in the body of the frog, and there is a distinct redness in the head. Here is a secret which our metallurgists must work out, for decidedly the round world has nothing like these objects, which are *sui generis.*"

American Institute of Mining Engineers.

REPORT OF PROCEEDINGS OF THE PHILADELPHIA MEETING.

(*Concluded from page* 19.)

WEDNESDAY, MAY 21, FOURTH SESSION.

AFTER calling the meeting to order, the President announced that the business first in order was the adoption of new rules for the Institute. Printed copies of a draught of rules were submitted to the members by the Council, and, after some discussion, were adopted with slight alterations. (The rules, as adopted, have already been printed in the JOURNAL.)

Prof. PRIME, of Lafayette College, Easton, invited the Institute to hold its next (October) meeting in Easton, which was accepted by the Institute, and the Council directed to appoint the day of meeting, to coincide as near as possible with the inauguration of the new Pardee building.

Mr. PECHIN, of Dunbar, Pa., then read a paper on Experiments on the Lucy Furnace near Pittsburgh, which has already been published.

Mr. DROWN—How long was it from the time they stopped blowing until they resumed again?

Mr. PECHIN—Three weeks.

Mr. HOLLEY—With reference to the subject of two rows of tuyeres, I would mention having seen a new form of elongated tuyere—18 inches in length—tapering from the bottom upwards. It is said to work well.

The PRESIDENT then read, in absence of the author, a paper on the Utsch Automatic Jig, by Mr. HENRY ENGELMANN, of La Salle, Illinois; also a paper by Mr. ELLSWORTH DAGGETT, of the Winnamuck Smelting Works, Utah, on the Economical Results of Smelting in Utah, both of which have also been published.

The PRESIDENT—The recent introduction of Connelsville coke into the Western smelting regions, in the place of charcoal, is a matter of much economic importance, not only on account of its superiority to the charcoal made in Utah, which is a very inferior article, but also from the fact that the "shortage" in the charcoal is very large, principally owing to the dishonesty and collusion of the contractors and agents.

Mr. PECHIN—How many bushels of charcoal to the ton?

The PRESIDENT—125. It will average 30 cents a bushel at the works.

Mr. PECHIN—Connelsville Coke will then be 34 cents in Salt Lake City.

The PRESIDENT—33 cents, I believe. They are getting coke somewhat cheaper from St. Louis. They don't mind a dollar or two a ton when you consider that one ton of coke is equal to two tons of charcoal.

Mr. PECHIN—I don't know of anything that illustrates more strikingly the amounts that go to railroad corporations than this.

Mr. SWEET—It is a good way from Connelsville to Salt Lake City.

The PRESIDENT—I could have brought some figures that I got in Salt Lake last summer, showing the prices paid for ore there by works at great distances from the ore supply, but near the fuel. Chicago was bidding desperately for ore, and St. Louis works were also actively bidding. The prices went up so that during the season at Salt Lake 200 tons were sold, assaying 47 per cent. in lead and 67 ounces of silver. Selby, of San Francisco, bid $64.70; "Maeder," $73.09, and Smith, of Chicago, $84. Now suppose Smith had been at Pittsburgh, we can see what the cost would amount to. $84 was the bid. Count $42 for the lead and $41.70 for the silver. Say for the ore $25, smelting $20, refining $12, and loss $14, making a total of $71; leaving as a margin for losses, risks, and profits, only $10 or $12, which is not enough.

The PRESIDENT presented to the meeting, from Prof. WM. POTTER, of Washington University, St. Louis, Mo., a very conveniently arranged note-book, for recording "iron" facts. The book, which is from the Students' University Press, was prepared by Prof. POTTER to facilitate the collection and arrangement of facts relating to blast and puddling furnaces as well as analyses of irons and iron ores.

The PRESIDENT then read the following papers by title:

On the Compression of Air, by Prof. B. W. FRAZIER, of Bethlehem.

On the Incidental Results of the Danks' Puddler, by THOMAS M. DROWN, of Philadelphia.

Prof. PETTEE offered the following resolutions, which were adopted:

Resolved, That the thanks of the Institute be tendered to our honored associate, Mr. FRANKLIN B. GOWEN, and to the Reading R. R Co., for the generous arrrangements for the comfort, convenience and enjoyment of members during the projected excursion to Reading, Pottsville, etc.

Resolved, That the Secretary be instructed to express to the Board of Trade the thanks of the Institute for the use of its commodious hall.

Mr. PECHIN offered the following resolutions, which were likewise adopted:

Resolved, That the American Institute of Mining Engineers has learned with pleasure of the cordial reception awarded to one of its managers, as its representative, at the recent meeting of the Iron and Steel Institute of Great Britain, and hereby extends to that body a hearty acknowledgment of its courtesy; and,

Resolved, That the Iron and Steel Institute of Great Britain is hereby invited to hold one of its meetings of 1874 in this country; and the Council is authorized to make such arrangements as to time and place for such meeting as shall suit the convenience of those who accept this invitation.

Adjourned.

The Denver and Santa Fe Railroad.

EXTRACT FROM THE REPORT OF 1873.

ALTHOUGH the road has been under construction throughout the year, with its business only partially organized, all of its departments new and crude, and a division of sufficient length to indicate what may reasonably be expected of the enterprise only turned over by the contractors to the company January 1, 1873, yet the results of the first year's working, even under these unfavorable circumstances, have fully vindicated the soundness of the views and correctness of the estimates upon which the undertaking was based.

The idea of a north and south railway following the eastern base of the Rocky Mountains from the principal city of the new West—Denver—southward to Mexico, arose from a conviction that this belt of country had especial advantages in its location, climate, and natural resources.

In the first place it was separated from the boundary line of arable culture on the eastward, in Nebraska, Kansas, the Indian Territory, and Texas, by a width of over 400 miles of arid plains, unfit for settlement except in occasional valleys, and only capable as yet of supporting a population of nomadic stock-raisers.

On reaching the foot-hills of this great chain, however, new conditions were found:

1st. Numerous streams of water pouring out upon the plains, and fed by the melting of the mountain snows. The slope being favorable to the distribution of this water over the adjoining land, the result was a fertile agricultural district, capable of raising food for a large population. Although this watered belt was not of great width, yet experience had shown that land cultivated by irrigation will produce much larger crops than the same amount under ordinary culture.

2d. The rugged mountains immediately adjoining on the westward had been found, wherever exploited, to contain veins and deposits of silver, gold, lead, copper, iron, and other metals. An active population of miners had begun to seize upon these treasures, and they required to be fed from the agricultural produce raised near the foothills.

3d. At numerous points along the whole belt named, from Denver to El Paso, on the border of Chihuahua, were found extensive deposits of good coal—frequently in connection with iron ore, lime, and fire-clay. This circumstance, and the water-power afforded by the rapid fall of the mountain water-courses to the plain, pointed out the country as especially fitted for manufactures.

4th. The adjacent mountains, with their outlying spurs, were covered with a large supply of pine timber for house-building, fencing, etc., also of the best building-stone and lime, while the parks and upper valley were especially adapted to making butter and cheese.

5th. The country on the east of this belt being, as already stated, for 400 miles a grazing district, treeless, too dry for culture, and offering no encouragement to population, the road was protected against competition from the building of a parallel railroad. The mountain country on the west, 400 miles in width, might be considered as impracticable in a north and south direction between its eastern and western base—in other words, as far west as the Salt Lake Basin, where the Mormons had already begun to develop on its edges the resources of the corresponding rim of good country at the west foot of the range.

6th. The climate, both winter and summer, of the plateau under consideration, in Colorado and New Mexico, was ascertained to be remarkably genial—the elevation above the sea, from 4000 to 7000 feet, being sufficient, in this latitude and at such a remote distance from the ocean, to make it healthful and uniform. Besides this, hot and cold mineral springs of medicinal virtue were found distributed at frequent intervals along the entire mountain base, and the scenery was everywhere picturesque and inviting.

7th. No less than eight lines of railroad, the Northern Pacific, Union Pacific, Burlington and Missouri River, Leavenworth and Denver, Kansas Pacific, Atchison, Topeka and Santa Fe, Atlantic and Pacific, and Texas and Pacific, had either crossed, or have since made more or less progress in the effort to cross, the great plains west of the Missouri River, for the purpose of tapping the resources of this Rocky Mountain region and its adjoining fertile slopes, in connection with the less reliable through trade sought by some of them.

It was a natural and inevitable deduction from all these facts that the country proposed to be traversed by the Denver and Rio Grande Railway was capable of becoming a populous and wealthy section.

To sum up: All of the conditions of climate, resources, and geographical position being thus highly favorable, any one familiar with the rapid manner in which the old West had filled up, could see that this district must have, inevitably, frequent large towns, prosperous agriculturists, dairymen, stock-breeders, wool-growers and farmers, free from serious tax of transportation to distant markets, numerous manufactures of iron, wool, wood, mining and agricultural machinery, cars, wagons, rails, etc., smelting works for the reduction of the precious ores, a large population of miners both for these ores and for the coal and iron, and frequent resorts for those seeking pleasure and health at the different mineral springs and points of scenic interest.

The territory described containing no navigable waters, had been cut off by the great plains, and by wandering tribes of Indians, from previous ready access. The first railroad had but just reached it from the east when the Denver and Rio Grande Railway Company was organized.

Although very sparsely populated, yet our conviction was strong that its exceptional advantages, in possessing that great variety in the elements of natural wealth which favors the largest and most rapid growth, would warrant the construction of this railroad through it; in fact, that the railroad itself would settle the country, and that the carrying of the emigrants, with all of their household and business plant, their first necessary food, and other supplies, would alone furnish a considerable immediate traffic, while their subsequent trade, the building up of large towns, and the growth of the mines and manufactures, would yield a permanent and lucrative transportation.

RESULTS IN ONE YEAR

After the Completion of the Railroad to Colorado Springs.

How far these expectations have already been realized may be shown by a few comparisons. Before the railway replaced the stage-coach from Denver to Colorado Springs, the latter ran tri weekly, and carried (as is shown in the prospectus of the company) an average of 5 passengers per trip, or 30, both ways, weekly. During the year 1872 the railway (while under construction) carried, on the same route, 25,168 passengers, or an average of 484 weekly, being an increase of over 1500 per cent.*

As regards tonnage, a few Mexican and other teams, before the railway was built, carried all there was. The actual freight hauled by the railroad in 1872 (an average distance of 61 miles) was 46,212 tons, or, leaving out construction material, it was 34,892 tons of commercial freight.

Again, by the United States census, taken immediately before the commencement of the Denver and Rio Grande Railway, *Denver* had 4800 population. To-day the city directory shows it to have a population of 15,000. *Pueblo*, the present terminus of the main line, had not over 500 people. A count made a few weeks ago shows that it has now, in the old and new town, a population of over 3500, which will in all probability be doubled the coming year. *Colorado Springs* did not then exist; now it has about 1500 people, and is continuing to grow at a ratio which will give it 3000 next year. *Colorado City* had about 300; it has more than doubled, while Littleton, Fountain, and other lesser points on the road which scarcely existed, are growing into important country towns. The farming population along the line has increased proportionately. Nearly 100 miles south of Pueblo a similar growth is shown, and Trinidad, which had but a few hundred people when the railroad started, has now 1100.

In the mountains adjoining on the westward, the mines of gold and silver have more than doubled their yield, which is now in Colorado from four and a half to five millions yearly. The Clear Creek and Boulder districts, immediately westward of Denver and of Boulder, have heretofore had the greatest development; but the rim of the South Park, west of Colorado Springs, has lately attracted great attention, and numerous mines are at work near Fairplay, while two establishments for the reduction of their rich ores have recently been built.

This extensive district promises most favorably both for silver and lead mining. During the past year the Denver and Rio Grande Railway has had the transportation of most of its ores (which reach the railroad at Colorado Springs) and of a large proportion of the supplies going to the mines. An excellent wagon-road has been built at the expense of El Paso County through the difficult cañon of the Fountain, connecting the railroad at Colorado Springs with the mines of the South Park and the saw-mills and forests of timber on the way. On the head-waters of the Arkansas new mines have also been opened, and the placer mining on the Maxwell estate has produced a large yield during the last year, because of the good supply of water; but the upper Rio Grande Valley and the San Juan country west of the San Luis Park have perhaps opened up the richest prospects. A considerable number of miners have gone in there, and everything indicates a permanent and valuable mining district. West of the extreme southern division of the road (650 miles south of Denver,) the Silver City district has grown into an important mining region, with several reduction works.

The excellent coal mines west of Pueblo, near Cañon City, have already been opened and mined by the Central Colorado Improvement Company, at the rate of from 50 to 100 tons per day during the winter: the beginning of an immense future coal trade.

* The estimate of passenger business that the road would carry the first year, as stated in the company's report, published before work was begun on the road, was 13 passengers both ways daily, or 182 weekly, between Denver and Colorado Springs. The actual result was 25,168 passengers carried an average distance of 67 miles, equivalent to 22,187 carried from Denver to Colorado Springs, or 426 passengers weekly—over 2 1-3 times the estimate.

The Compression of Air.

By PROF. B. W. FRAZIER, Lehigh University.*

AT a recent meeting of the North of England Institute of Mining and Mechanical Engineers, during a discussion upon the compression of air, attention was called to an apparent anomaly in the phenomena attending the compression. At a subsequent meeting this apparent anomaly was explained by Prof. HERSCHEL, and all the facts observed shown to be strictly in accordance with the laws of thermodynamics.

Upon reading the report of the discussion in the published transactions of the society, it occurred to me that an attempt to determine mathematically the amounts of energy (whether in the form of heat or of work) expended and absorbed in compressing air and causing it to perform work by expansion, might prove of use to some who have not access to any treatise upon the application of the laws of thermodynamics to the compression of air, and who have not the time or the inclination to make such application for themselves.

The apparent anomaly noticed was this: If air be compressed, and at the same time, by the sufficient application of a cooling medium, kept at a constant temperature, the indicator diagrams in the steam and in the air cylinders will have substantially the same area—showing that all the work of the motor is employed in compressing the air; and yet there is besides a development of heat, rendered evident by the raised temperature of the cooling medium. The questions were asked: Whence comes this heat? Whence can it have come without any work apparently being registered to produce it? Prof. HERSCHEL, in his reply, very truly said that the indicator diagram represents the work performed *upon* the air, and naturally must correspond to the diagram of the motor; but that it does not show what has become of that work. "If we look for that work in the cylinder at the end of the stroke, we must not expect to find it all as compressed air, and must look for some of it, at least, as heat."

He might have gone farther, and have said that we must look for *all* of it as heat; in other words, all the work performed in compressing the air has been transformed into heat, and carried off in the shape of sensible heat by the water, (supposing that to be the cooling medium.) This statement may at first sight appear even more of a paradox than the problem which it purports to answer, but it admits of easy proof; indeed, its truth will be, upon a moment's reflection, apparent to any one acquainted with the thermodynamic properties of a perfect gas, which, for all practical purposes, air is.

The cause of the confusion of ideas, which sees in the heat abstracted by the water an apparent contradiction of the fundamental physical law that we cannot create energy, is, in my opinion, the neglect to take into the account the *intrinsic energy* possessed originally by the air which is compressed—and also that possessed by the air when it leaves the working cylinder after its expansion.

The intrinsic energy of a fluid, as defined by RANKINE, is the energy which it is capable of exerting against a piston in changing from a given state as to temperature and volume, to a total privation of heat and indefinite expansion.

In the case of a perfect gas this quantity is a function of the temperature and of the temperature only. It is therefore constant when the temperature is constant, no matter what variations may be made in the pressure and volume. It is understood, of course, that at constant temperature, the pressure and volume cannot be both at once *arbitrarily* varied, the relation between them being expressed by Marriotte's law, viz.: that the volumes are inversely as the pressures, or $p_0 v_0 = p_1 v_1$.

The expression for the value of the intrinsic energy of air at a given temperature is $\kappa\tau$, in which τ is the *absolute* temperature, or the temperature counted from the absolute zero; the absolute zero being that temperature at which gaseous elasticity disappears.

κ is the dynamic specific heat of air at constant volume, which, considering air to be a perfect gas, is the same as its *real* dynamic specific heat.

The value of κ is given by the equation

$$\kappa = \frac{p_0 v_0}{\tau_0} \cdot \frac{1}{\gamma - 1}.$$

In which

p_0=mean pressure of atmosphere in lb. per square foot=2116.3.

τ_0=493°.2 corresponding to 32° F.

v_0=volume in cubic feet of one lb. of air at pressure p_0 and temperature τ_0= 12.387 cubic feet.

$\gamma = \frac{\kappa}{\kappa v}$ =ratio between specific heats of air at constant pressure and at constant volume=1.408.

$\frac{1}{\gamma - 1}$=2.451.

If $\tau = \tau_0$. $\kappa\tau_0 = \frac{p_0 v_0}{\gamma - 1}$=64,250 foot pounds.

One pound of air, then, at mean barometer pressure and 32° F., possesses an intrinsic energy of 64,250 foot pounds, and it is upon this store of energy that we draw, when, after having abstracted in the form of heat all the work we had expended in compressing the air, we yet cause it to perform work by expansion.

Representing by

I. The intrinsic energy possessed by the air before compression.

I_1. The intrinsic energy of the air after compression.

I_2. The intrinsic energy of the air after expansion.

W. The work performed in compressing the air.

W_1. The work performed by the air in its expansion.

H. The energy in the form of heat abstracted by the cooling water.

Assuming that the air is compressed at a constant temperature, which remains constant until expansion commences, and that there is no accession of heat during expansion; neglecting also all work lost in overcoming friction, &c.; then the equation,

$$I + W = H + W_1 + I^2 \quad (1.)$$

must be true.

In other words, the sum of the quantities of energy, in whatsoever form, either entering with the air, or added subsequently to it, must be equal to the sum of the quantities of energy abstracted in the shape of heat and of work, and of that which leaves the working cylinder in the air as it escapes.

Let us trace the stages of the operation, step by step. We take air having the intrinsic energy I. We add to it an amount of energy W=work of compression, but, at the same time, we abstract from it an amount of energy H, in the shape of heat.

Representing by I_1 the intrinsic energy of the air after compression, we must have

$$I + W - H = I_1.$$

But we have assumed that during the compression the temperature is constant. The energy possessed by the air after compression must consequently be the same as that which it had originally: $I = I_1$

Consequently $W = H$.

Or, as we have already stated, *all* the work of compression is transformed into heat.

Now it is that we take advantage of the intrinsic energy of the air, in causing it to perform work by expansion, notwithstanding the fact that we have abstracted, as heat, all the energy we have added to it.

$$I = W_1 + I_2,$$

or $W_1 = I - I_2$. The work performed by the air has been entirely at the expense of its intrinsic energy. Its energy when it leaves the cylinder is less than its original energy by a quantity exactly equal to the amount of work performed. This diminution in energy is rendered manifest to our senses by the corresponding diminution in temperature, which occurs during the expansion. The air is colder as it leaves the working cylinder than it was when it entered the compressor.

Let us follow the air after it leaves the cylinder, and observe the subsequent change in its condition. Let us suppose that the pressure and temperature of the atmosphere surrounding the working cylinder are the same as that surrounding the compressor. The air upon leaving the working cylinder being colder than the surrounding media, absorbs heat from them and expands until it attains the same temperature as they have. By our hypothesis, this is the original temperature of the air before compression. Its final intrinsic energy will consequently be the same as its original energy.

Representing by H_1 the heat absorbed, and by W_2 the work performed by the air after it leaves the cylinder, we have

$$I_2 + H_1 - W_2 = I.$$

or

$$I_2 = I - H_1 + W.2$$

Substituting this value of I_2 in equation (1), we get

$$W = H + W_1 + W_2 - H^1. \quad (2),$$

or

$$W - (W_1 + W_2) = H - H_1.$$

But $W = H$—consequently $W_1 + W_2 = H_1$

and

$$\frac{W}{W_1 + W_2} = \frac{H.}{H_1}$$

The ratio between the work expended in compressing the air and that performed in its expansion is equal to the ratio between the heat abstracted from the air by the cooling water and that absorbed by the air after it leaves the working cylinder. It must be borne in mind that of the work performed during the expansion of the air, there is utilized only the portion performed in the cylinder, or W_1.

Equation (2) may be put in the form

$$H = H_1 + W - (W_1 + W_2).$$

This equation suggests another method of explaining the supposed anomaly. The heat rendered evident in the heating of the water, which cools the air in the compressing cylinder, may be said to be in part derived from the media surrounding the working cylinder. These media may be the air and rocks in a mine, many fathoms, perhaps, below the surface where the compressor is placed.

When compressed air is used in a mine, there is a constant flow of heat from the mine to the surface. The air is the vehicle of the transfer, transmitting by its action not merely work from the surface to the bottom of the mine, but also heat from the bottom to the surface. It is owing to the original intrinsic energy of the air that this double transmission is possible.

I will now endeavor to determine the values of the quantities of energy represented by the symbols I, W, H, W_1, H_1, and I_2, for one pound of air.

We have already assumed the expression for I.

$$I = \frac{p_0 v_0}{\gamma - 1} \cdot \frac{\tau^1}{\tau_0}.$$

We shall have later an occasion to indicate one method by which it may be proved,

*Read at the Philadelphia Meeting of the American Institute of Mining Engineers, May 21, 1873.

W, being the work performed by compressing air at a constant temperature, may have its expression obtained by integrating $-pdv$ between the limits v_1 and v_2, —the relation between p and v being given by the equation $pv=p_1 v_1$, which expresses Marriotte's law.

We have then

$$W=\int_{v1}^{v2} -pdv=p_1v_1 \int_{v1}^{v2}\frac{dv}{v}$$

$$=p_1\ v_1\ l\frac{v_1}{v_2}$$

$$=p_1\ v_1\ l\frac{p_2}{p_1}$$

$$W=2{,}3026\ p_1v_1 \log\frac{p_2}{p_1}$$

$$H=W=2{,}3026\ p_1v_1 \log\frac{p_2}{p_1}$$

$$H\text{ (in thermal units)}=\frac{W}{772}$$

When the air arrives at the working cylinder its pressure, volume and temperature may all be changed.

Representing by $p_3\ v_3$ and τ_3, these respective conditions of the air before expansion, and by $p_4\ v_4$ and τ_4 the pressure, volume and temperature it has when it leaves the working cylinder, we have

$W_1=\int_{v3}^{v4} pdv$. The relation between p and v being given by the equation

$$pv^{\gamma}=p_3\ v_3^{\gamma}=p_4\ v_4^{\gamma}.$$

$$W^1=p_3v_3^{\gamma}\int_{v_3}^{v^4}\frac{dv}{v^{\gamma}}=\frac{p_3v_3^{\gamma}}{\gamma-1}\int_{v_3}^{v^4}\frac{\gamma-1\ v^{\gamma-2}\ dv}{2(\gamma-2)}$$

$$=\frac{p_1v_3^{\gamma}}{\gamma-1}\left(\frac{1}{\gamma-1}=\frac{1}{\gamma-1}\right)_{v_3}^{v_4}$$

$$=\frac{p_3v_3}{\gamma-1}\left\{1-\left(\frac{v_3}{v_4}\right)^{\gamma-1}\right\}.$$

$$W_1=p_3v_3\left\{1-\left(\frac{p_4}{p^3}\right)^{\frac{\gamma-1}{\gamma}}\right\}.$$

$I_2=\frac{p_4\ v^4}{\gamma-1}=\frac{p_0\ v_0}{\gamma-1}$. $\frac{\tau_4}{\tau_0}$ is the expression for the intrinsic energy of the air as it leaves the cylinder.

W_2, the work of expansion of the air after it leaves the cylinder, is performed at the constant pressure p_4 (supposing that the expansion is carried in the working cylinder to the pressure of the exterior atmosphere), consequently

$$W_2=p_4(v_5-v_4)$$

$$=p_4v_4\left(\frac{v_5}{v_4}1\right)$$

But as the pressure is constant

$$\frac{v_5}{v_4}=\frac{\tau_5}{\tau_4}.$$

We have therefore

$$W_2=p_4v_4\left(\frac{\tau_5}{\tau_4}-1\right)=p_0v_0\frac{\tau_4}{\tau_0}\left(\frac{\tau_5}{\tau_4}-1\right)$$

TO BE CONTINUED.

MINING SUMMARY.

New Mexico.

Extracts from a correspondence of the Cimarron *News* of June 28.

SILVER CITY, June 10, 1873.

Our machinery for the reduction of ore consists of two five-stamp mills with Wheeler pans, one Jaw Crusher and Pulverizer with Freyberg pans, one rotary six-stamp battery with barrel amalgamators, and one ten-stamp mill with six Varney pans. This latter mill which is owned by V. S. SHELBY & Co., is as fine a mill as can be seen anywhere, and has a capacity of seven or eight tons per day. In addition to these, POPE & Co. have almost completed another ten-stamp mill, similar in its construction and machinery to the one last mentioned. Much of our ore requires to be smelted, but as yet we have no works of that kind except two or three crude Mexican furnaces which are of small account. Prof. FISH, who represents a Chicago company, is about to supply facilities for the reduction of this class of ore by erecting extensive smelting works. His machinery has been shipped already over the Atchison, Topeka & Santa Fe R. R. and is expected here soon.

The mines, as far as discovered, embrace three districts, known respectively as Chloride district, Silver Flat Hill district, and Lone Mountain district. The ores from all of these are essentially of the same class, but each has a different veinstone and differs in some respects from all the others. Chloride district is located 2 miles from town, in a small dry valley between limstone hills, the bottom of this valley being a formation of clay slate which overlies the limestone. The mines are confined to one side of this valley, and extend back a considerable distance on the limestone hills, but are richest and most numerous near the junction of the slate and limestone, which in some places is a perfect network of veins, pockets, and deposits of high grade ore. One of the principal ores of this district, as its name implies, is Chloride of silver—the hornsilver of the miner, and the *plata blanco* of the Mexicans. It is the easiest of all the ores of silver to reduce, and from it most of the silver produced here has been taken. The next most important bases are Galena and Carbonate of lead, both of which are rich in silver, and are the finest of ores to smelt. Silver sulphurets are found along with all the other ores. The veinstone, or gangue, in this district is chiefly calcspar, and its massive and shining crystals make a showy setting for the beautifully collored ores. As to the permanence of these mines, I can give no better information than that derived from the fact that at the depth of 140 feet—the deepest shaft yet sunk—a large body of ore was found last week, excelling in richness any yet taken from the same mine. It is indeed an almost pure mass of carbonate of lead and sulphurets of silver, and from tests made, will work $300 per ton in the furnace.

Silver Flat Hill District is located one-half mile from town, on a hill with a limestone Cap overlying a formation of feldspathic granite. The veinstones here are quartz, and the veins large, carrying ore of various quality, from that which will not pay $20, up to that which will yield more than $200 per ton. The principal ore is sulphurets; there is a small quantity of chloride, while in some of the richest mines specular iron is very abundant, and in others, carbonate of lead. No work is being done in this district at present. The ore being too refractory to be successfully treated by raw amalgamation. It is a matter of regret that not sufficient depth has been attained on this hill to demonstrate whether veins penetrate the granite which underlies the limestone at no great depth.

Lone Mountain District is located nine miles from Silver City, along the base of a solitary mountain of limestone which rises out of the surrounding plain. The veins crop out very distinctly on the surface of the bare and solid rock, and are very numerous, seaming the limestone in every direction, and intersecting each other at every conceiveable angle. Many of them are small, showing but a few inches width on the outcrop, others are large, and many of them, both large and small, are traceable for a distance of 1,000 or 2,000 feet, or to where the limestone is covered with earth and gravel. One naturally infers that the veins cannot be superficial, but must have at least a corresponding extension downwards into the dominions of Pluto. The deepest shaft in the district is only sixty feet, at which depth the vein is stronger and the ore better than at the surface. The gangue is spar and quartz, and the ore chloride sulphurets and carbonate of silver, with carbonates of lead and copper, and some galena. The average value of that from the best mines is very high. Pieces of a few pounds weight have worked as high as the rate of $27,000 per ton, but it is needless to say that such pieces are scarce, for any miner knows that in any silver mines on the earth it would take about 27,000 years to collect a ton of $27,000 ore. There is plenty of water for milling purposes at Lone Mountain, and one five-stamp mill is in operation. Two miles further east on a level plain are the Warren's Flat mines; little work has been done on the claims yet, but enough to bring to sight some large bodies of fair grade ore.

Taking the mines altogether, I say with confidence, that we have a considerable amount of ore that contains $75 to $100 per ton, and upwards, and this I call high grade, while the mines that yield $40 to $60 per ton are very numerous, and capable of producing an abundance of ore.

And yet with this fair showing for our mines, and while our milling capacity is considerable, I am compelled to admit that times are dull, and but a small amount of bullion being produced. In as few words as possible I will try to explain these apparently irreconcileable statements. The fact is that the raw amalgamation process has proved here, as it did in Colorado and Nevada, a failure. Our mills have so far worked solely by this process, there being no roasting apparatus of any kind in the camp, and the result obtained from most of the ore worked is the extraction of 40 to 60 per cent. of its assay value, and sometimes even less than this. It follows that one which contains $100 per ton only yields in the mills from $40 to $60, which after paying for mining and hauling, and the heavy milling charges, generally leaves the miner in debt, when he should have realized a profit of more than $40 per ton. The most competent metallurgists in the mines will confirm this statement, but the best confirmation is afforded by the millmen themselves. They save their tailings, and after allowing them to lie for a few months exposed to the decomposing influences of salt, air and water, they are found to pay for working a second time. With these facts and this experience before them, the miners who have good ore cannot and will not take it to the mills to be treated by this wasteful and inefficient process, hence little is being done in the mines. Some of the mills are not running; trade is dull, and bullion shipments insignificant. It is hoped and expected that this unsatisfactory state of affairs will be remedied soon, by the introduction of roasting cylinders, into one or more of our best mills. We have the assurance of an able and experienced metallurgist that by this improvement to our present machinery, ore can be worked to 90 per cent. of its assay value. In a matter so vital to their own interests, and to the interests of all, I cannot believe that our enterprising mill owners will longer hesitate and delay.

Nevada.

GOLD HILL DISTRICT.

From the Gold Hill *News* of June 28.

LOWER COMSTOCK.

Work is actively resumed to develop the valuable claim of the company, situated on the lower portion of the branch of the great lode leading down Gold Canyon. The claim lies on the west side of the canyon, within the limits of Silver City, and opposite the town. It is finally secured by United States patent, and various tunnels run into it in times past from the ravine have pretty well defined the position and value of the main ore vein, which is from 70 to 100 feet wide. The quartz is of a fine character, and gives good assays. The old prospecting shaft of the company is 125 feet in depth, and cut into quartz very much resembling the rich Ophir ore of years ago. There is every evidence to induce the belief that a rich, extensive and valuable mine will be developed when adequate depth is attained. With this view the company commenced last Saturday the sinking of a large working shaft of three compartments, which, it is calculated, will cut the ledge at the depth of 800 feet. The first level, however, will be opened at 400 feet for a drift west to the ledge. Pay ore should, and probably will be found at that depth. The shaft is already thirty feet deep, and the contract for the first 100 feet is let to R. A. Young, of Silver City.

CROWN POINT EXTENSION.

This mine, adjoining the Crown Point and Belcher to the southward, on the branch of the great lode leading down Gold Canyon, is now about to be practically opened and developed. The title is finally secured by United States Patent, and all things in that line being completed, the company on Monday last commenced sinking a large working

shaft of three compartments. It is eligibly located on the north side of the Canyon, a short distance below the Jones residence, and Mr. R. A. Young, of Silver City, has the contract for sinking the first 100 feet. It is already down about twenty feet, making very good progress. As soon as practicable, powerful steam hoisting works will be erected, with the intention of sinking to the depth of at least 1,000 feet, at which point it is expected to intersect the ledge, when good pay ore is anticipated. The new prospecting shaft of the Front Lode Mining Company being sunk a few hundred yards farther down the canyon, on the same lead, is fifty feet deep, and already shows very favorable looking vein matter.

AMERICAN FLAT.

Sinking the incline is making good progress, with the bottom in quartz and porphyry. The company having contracted with the Baltimore Consolidated for the privilege of running a drift from the main west tunnel on the 450-foot level of that mine, so as to cut the ledge and prospect their mine at a much less expense than would otherwise be required, are making good progress with the same. The ground of this company was located in December, 1859, and was known as the American. The Baltimore ground north of it was located in January, 1860, and both claims were consolidated under the name of Baltimore-American. The American ground was subsequently segregated and received its present name of the American Flat. The Baltimore company then consolidated with the Oregon company and became the Baltimore Consolidated, its present name. The Franklin lies immediately west of the American Flat and also adjoins the Baltimore. The Rock Island lies southwest of the American Flat.

BELCHER.

Daily yield 500 tons, about 125 tons of which comes from the 1300 or lowest level through the Yellow Jacket shaft. The main south drift at this level is in 280 feet from the Crown Point line, with the face still in fine ore. The cross-cut east from the sill floor, 100 feet from the Crown Point line, and the cross-cut east from the fourth floor above, seventy feet from the Crown Point line, are both in over 100 feet from the east side of the ore stopes, and still show spots of ore. This level thus far shows better than either of the levels above, all of which, however, are looking and holding out finely. At the 1200 foot level the cross-cut east shows thirty-nine feet of fine ore, which bids fair to open out into a large body. The main incline is now down below the 1200-foot level. A station is being opened for that level, and the incline will be continued downwards as soon as the station is opened and the drift north fairly started.

SAVAGE.

The south winze from the 1600 to the 1700-foot levels made the connection last Wednesday, giving a much needed circulation of pure air, cooling off the 1700-foot level and affording an opportunity of cross-cutting the ledge and developing the real value of that level. The north drift on the 1600-foot level having made connection with the Gobld & Curry also gives a fine chance to prospect the large body of virgin ground that lies between the 1500 and 1600-foot levels in that part of the mine.

BALTIMORE CONSOLIDATED.

Work on both the 225 and 450-foot levels has progressed steadily during the week, with the exception of a few hours' delay caused by the breaking of one of the reels. The ore body on the 225-foot level is gradually widening and improving in both looks and quality. The main west drift on the 450-foot level, although running in vein matter, has not yet cut the main ledge. Water does not interfere with the work.

SENATOR.

Twelve feet have been added to the depth of the shaft this week, making it now 366 feet deep. Some water is coming in at the north side of the shaft. It is of a milky color and quite warm. There is not enough of it, however, to give any trouble. The east side of the shaft shows the most quartz coming in. It is of a fine quality. An assessment of fifty cents a share, amounting to $12,000, was levied last Tuesday.

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Nov 19:1y

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Nov. 21:1y

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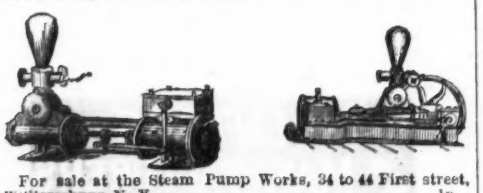

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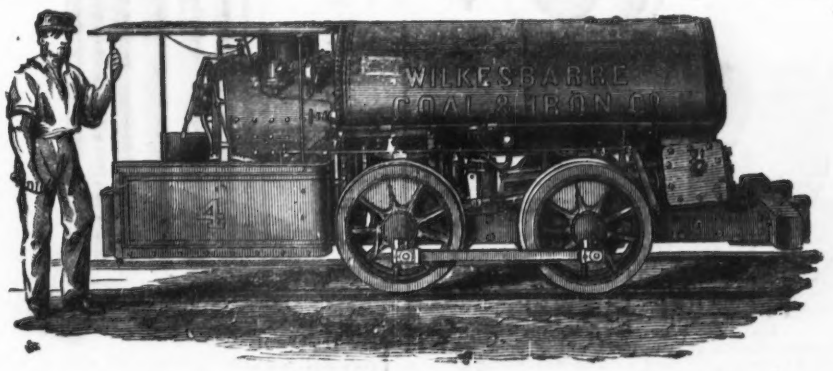

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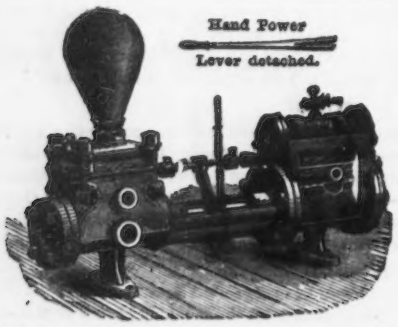

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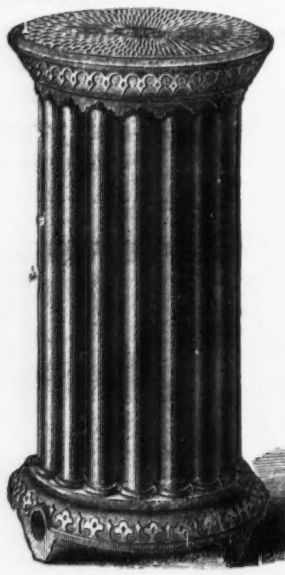

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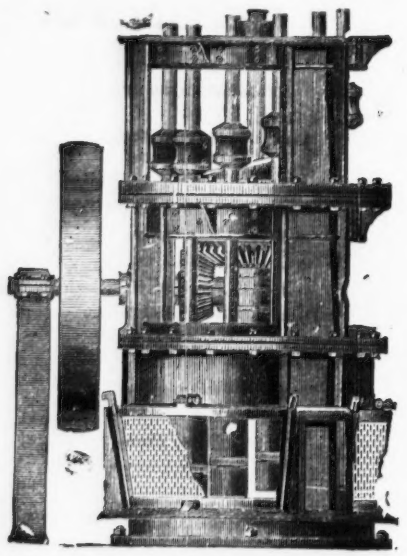

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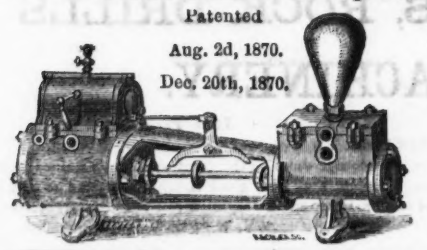

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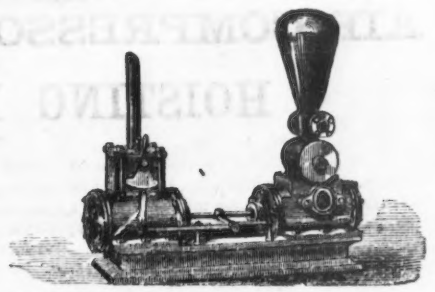

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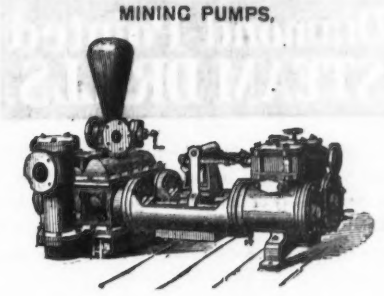

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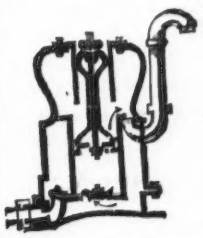

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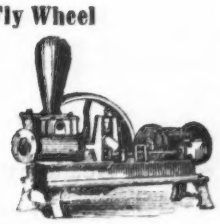

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